JOURNAL

OF THE

AMERICAN FOUNDRYMEN'S

ASSOCIATION.

VOL. 2. JUNE, 1897. NO. 12

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PROCEEDINGS OF THE SECOND ANNUAL CONVENTION OF THE AMERICAN FOUNDRYMEN'S ASSOCIATION.

DETROIT, MICH., MAY 10, 11, 12, 13, 1897.

The visitors assembled in Harmonie Hall at 2:30 o'clock p. m., on Monday, May 10, and the meeting was called to order by John R. Russel.

Mr. Russel—In expressing the committee's thanks for the acceptance by the Association of our invitation to meet in Detroit, we can take very little credit for the very large number of gentlemen here, especially when we consider the meeting in Philadelphia last year. There was one thing definitely proven at that meeting, and that was that the result was to be a success. Probably more than 500 gentlemen met in Philadelphia at the invitation of the committee there, and it was very plainly shown that an association was sadly needed. The success of the last meeting was very largely due to the most hospitable reception given to us by the gentlemen in Philadelphia. Detroit, as you know, can hardly be compared with that city, yet at the same time, in a mercantile way, it is of considerable importance. You

are probably aware of that, but you are not aware that whenever a Detroiter is led to speak of his city he refers to it from rather a historical point of view, not that we have anything particular to boast of, but more perhaps from a matter of habit. If I may be allowed I will tell you, and this is a matter which should be of interest to foundrymen, that Detroit was founded in 1698 and was foundered in 1891. Through this long period, almost a couple of centuries, we have been rather warlike. We had to contend at different times during this long period, with the English, with the French, and with pretty nearly all the tribes of Indians that could get here. To prove that we were successful during this period of contention we have only to display to you our beautiful city. And that we were successful in our second period, which might be called a period of political activity, I think I cannot do better than to place in evidence a gentleman who is better able than I am to explain. I have therefore great pleasure in introducing Mayor William C. Maybury, whom it has been the privilege of Detroit to honor.

The Mayor. Gentlemen—It affords me very great pleasure to welcome you to the City of Detroit. When the committee waited upon me, the committee of our local foundrymen, to ask me to say a word of welcome to you on your coming, I was led to ask them as to whether it was possible that foundrymen throughout the United States were as handsome as the foundrymen of this city, and they said to me: "You come and see." I said to them that there must be something of a secret about the manner in which they preserved their physical beauty and proportions, and they had the effrontery to say to me that it was only due to the fact that they did a good hard day's work, and did not get more than 200 per cent profit on their goods; and thus, with a quiet and easy mind, they could rest at night. If that is the history of foundrymen the world over I think I shall ask to be elected a member of this organization, as I should like a little of that rest myself, as well as a little of the profits. We have a great many things here in Detroit to show you. We always speak enthusias-

tically of our water, we have an abundance of it. You may possibly test the hospitality of the foundrymen in Detroit in several directions, but they will catch you on the water. It may be used for all purposes, and I want to say to you also that we have soda water here and its character depends upon whether you wink at the boy behind the bar or not. If you do not wink you get soda water. Now I am glad you started your first convention here in Detroit. It is a good place to start in, for if a thing starting here does not go right it goes over to Canada, that haven of rest. The chief of police was kind enough to ask whether any special orders were to be given on this occasion. I said yes, there are special orders. If you find anybody on the street boisterous arrest them at once, and you can be well assured they are not visiting foundrymen, because I have the assurance of the committee that they have come here to have a very very quiet time. You are peculiarly fortunate in this respect. If any of you should happen to be taken ill you need not ring for the ambulance or call loudly for a doctor, for I do not know what kind of a foundryman John Russel is, but he is a mighty good doctor. I want to say to you that I look upon it as one of the progressive marks of the times that men have forgotten the narrowness of the ages long passed, and are willing to come together as you have come to exchange the best you have for the best your neighbor has. When we read of the excavations which have been made in the old world and of the things which have been unearthed there we see that some of the useful arts to the world have disappeared. You cannot reproduce to-day what is being dug at Pompeii. The hills around Jerusalem in the far east tell us that in certain arts and sciences we are not equal to what they were in those days. Why is that so? Because when it was given to any man to have the genius to discover anything of a useful kind he was not willing to take simply the profit of it to himself for all time, but locked it in his heart and made it an heirloom to be handed down to his family. In some cases at the death of the man it passed out of existence, and in this way many of the useful arts and sciences were forever lost. But when you, my friends, are willing to come together and give one another the best you have of your expe-

rience and your knowledge, the art which you are building up will grow, and can never fade away in its usefulness to the world, and for that reason I congratulate you, and as a citizen of this city and of this country, I thank you for showing that liberality which will, in my judgment, do more in the progress of civilization than anything else. In the days of the great Protector Cromwell he recognized that in drawing from the different trades, and the artisans of England, Ireland, and Scotland, the men to recruit his army, he was leaving at home an idle population, and you know his army remained for many years in camp. Their battles were very few, and with that wisdom that marked so much what the great Protector did, he recognized that the time had come when that army should scatter and each man go to his own village. He made up his mind that when his army scattered he would send home, not the idler, but the well equipped citizen. He would send home every man with a useful trade, and as a result he started in the various camps of his army schools of instruction, called in the best artisans from outside, picked out the men in the army the most skilled in their different trades, and placed teachers over the others, and every man was obliged to learn some useful occupation; and when they scattered to their homes and in after years a man was found here and there who was most skillful in his work, who knew his business a little better than anyone else, the people looked at each other and said: "That man was one of Oliver's soldiers." There was the beginning in modern times of this idea, the exchange of ideas in art and science that the world might be the better for it. Coming with this noble purpose, I greet you heartily on behalf of the people of this city, and say to you, Welcome, thrice welcome.

Mr. Evans. I think under the circumstances the Mayor has ably won this badge. He said he wished to become a member of this guild, and with your and his permission I will pin it upon the lapel of his coat.

Mr. Russel. Last year, at Philadelphia, we listened to a very able and eloquent address from a gentleman of that city, Mr.

Pfahler, a stove manufacturer. We have with us to-day a gentleman representing the same walk in life, and while he may not be as good-looking as the gentleman from Philadelphia, yet he stands as high, certainly, in the esteem of his fellow citizens. I refer to Mr. Barbour.

Mr. Barbour. Mr. President, and Members of the American Foundrymen's Association—I feel a little bit embarrassed since my friend Mr. Evans and the other gentlemen on my right have noticed no doubt that I have taken the liberty of pinning this badge on myself prior to making any remarks, and the Mayor was honored after his speech by a formal presentation of his badge. I am glad in behalf of the manufacturers and founders of the City of Detroit to welcome you here. I assure you it is a great honor to be extended the privilege of meeting you here and extending a hearty welcome in their behalf. My friend Russel referred briefly to the advantages we have here in this City of Detroit, and then his honor alluded to the beautiful river. I will go a little farther. In the first place, we have great reasons for feeling proud of our city, and I see in this audience many faces that have been here before, Mr. Pfahler and others, and I want you all to become well acquainted with Detroit. The Mayor spoke of the police, but you need not be afraid of them. If you should get into trouble just appeal to the Mayor or to me, we will see you through. Several years ago when John J. Bagley was Governor of Michigan, he had the honor of meeting the National Association of Stove Founders, and he made some remarks similar to those just made by my friend Maybury. He said: "You know we have a great river. It is magnificent water to bathe in and to wash your faces and hands in, but I want to caution you on one point, and to make that point emphatic, and that is do not take too much of the water into your stomachs." While water is a good thing, and I believe in it, its use can be carried to excess. We have distilleries, but while they are on the other side they are in sight all the time. If you take the water in limited quantities you will find it all right, I have tried it myself. I think we are favored with elegant weather, and we are in hopes that this sort of weather

will continue for you. The committee who have the matter of entertaining you in charge have worked hard and have quite a programme for you to go through. After the laborious work you will have in your meetings a little recreation will do you good. I believe that all business men, and manufacturers, foundrymen in particular, who are engaged weeks, months, and years, make a mistake in not taking recreation enough, and while we meet together here, and it is an advantage to business men to meet and exchange ideas, you should take in the programme laid out for you for recreation. I assure you our foundries and manufactories are wide open to you. Come whenever you like, we are glad to see you, and if we can do anything for you and show you our methods I can assure you that the institution I represent will be glad to show you anything you want and to answer any questions you may put. I am glad to welcome you here and hope you will have a pleasant and enjoyable time.

Mr. Russel. Referring more particularly to the programme Mr. Barbour has referred to, your committee wish to say that the general outline of the programme for the day will be published in the papers each morning, and in that way you can keep fully advised of what a day's proceedings will be. This evening you will have a paper with stereopticon views by Mr. Penton. You will have a business meeting to-morrow morning, a boat ride in the afternoon and a general reception in this hall on Wednesday evening. This is what we have in mind at present, anything further will be announced at the meetings or through the papers. I think Mr. Schumann will now take charge of your deliberations.

President Schumann. I desire on behalf of the Association to express my thanks for your very pleasant greeting, and I believe the foundrymen are under very great obligations to the gentlemen who have favored us with their presence, and to the committee who have made such elaborate preparations to entertain us. We all know of the City of Detroit, of its hospitalities and of its politics, no matter how far we live away from it. We likewise know the enterprising spirit of its citizens and are not disappointed in the reception we have received. I am sorry that the

foundrymen, like the members of other organizations, allow the business of the first day of a convention to be attended to by a few of their body, under the idea that there will be plenty to attend to the business and that they can come in later. That theory accounts for the rather small attendance here this afternoon. I again thank you for your hearty welcome.

I will now ask the indulgence of the meeting and will read my address.

PRESIDENT'S ADDRESS.

"It is with great pleasure that I exercise the honor conferred upon me of presiding at the second Convention of the American Foundrymen's Association, and of enjoying with you the hospitality of our friends and fellow-members of this fair City of Detroit.

In calling to order this second Convention of our Association, I am profoundly impressed with the importance of our actions in their influence upon the welfare of those engaged in the pursuit of our industry.

We have come here from all parts of our country, some many hundred miles, as representatives of a vocation practised in remote antiquity, the development and elevation of which into equal rank with other mechanic arts, is of quite recent date.

We are here to evolve and formulate ways and means towards the advancement of our industry, both as a mechanic art and as a source of benefit to those engaged in its practice. No better evidence as to the final attainment of our object could be desired than that of the rapid growth of this organization, which, after one short year of its existence, includes in its membership those representing hundreds of establishments—the result exceeding the most sanguine expectations.

It is our primary purpose to establish a more cohesive bond of unity amongst all engaged in our art, to adopt and practice wise and proper methods and to confer upon and discuss subjects affecting our general welfare, both technical and economical.

The present condition of our industries affords cause for serious reflection. Our productive capacity seems to have outgrown the consumption; our country, rich in all that is necessary to life

and happiness, yet suffers from lack of proper circulation and want of balance. The farmer has corn, wheat and cattle in abundance; the coal miner is burdened with a stock of coal; the railroads have many idle cars and locomotives prepared to transport goods, and the iron and textile manufacturers have idle men ready to manufacture the products of the soil.

The extraordinary demand resulting from the destructive consumption of the Civil War, in addition to the demand due to the rapid growth of our country between the years of 1870 and 1880, stimulated our industries to an abnormal degree; they expanded on a basis erroneously assumed to be continuous; labor was tempted to forsake the farm and immigration was deflected to the industrial centers.

Capital, sensitive to conditions and realizing the precarious nature of its investments, a realization intensified by reason of the low standard of ethics in vogue in corporations, notwithstanding the laws of the land, has contracted its advances and enforced a lessening of the differences between the actual capital invested and the fictitious amounts upon which business is transacted.

From 1867 to 1870 the increase in the population was at the rate of 2 per cent per annum; from 1870 to 1880 this had increased to 2.7 per cent, while from 1880 to 1883 it fell to 2.3 per cent, and from the latter period until now, it is about 2.2 per cent annually, the increase being for the two decades between 1870 and 1880, 30 per cent and 24 per cent respectively.

In agriculture, fisheries and mining, there were engaged of the total population a shade more than 16 per cent in 1870, a shade less than this in 1880, and not quite 14½ per cent in 1890, a gradual decrease in the proportion of those who produce the essentials.

In manufacturing and mechanical industries, the proportion was about 6 per cent in 1870, increasing to 6.8 per cent in 1880, and reaching above 8 per cent in 1890, thus showing that the growth in the population of consumers of manufactured articles is checked, while that engaged in the industries is rapidly growing.

The result is an evident excessive producing power, accelerated by the advances made in the sciences and mechanic arts in producing labor saving devices.

How can the excessive capacity to produce be controlled and utilized to improve the conditions? It is within the province and is the duty of this body, as well as all similar organizations, to consider this subject and to formulate and give expression to such thoughts as will lead to a satisfactory solution of the problem.

The lessening of the cost of things, diminishing the burden of labor, making life more pleasant, happy and contented, are all desires that may be satisfied by the use of the steam plow, the mower and reaper, the power loom, the power crane, the molding machine, the wood-working machine, the typewriter and so on indefinitely. That all labor saving machines can and will be beneficial to mankind, cannot be denied—so far, however, the greater benefit has been limited to the few, but that the benefit will finally reach the masses, is as true as that mankind is progressing; it will reach them in the lessening of the hours of labor, in bringing within reach things that go to comfort and make men happy, contented and healthful in mind and body.

Lessening the hours of labor seems to me the most vital question available for immediate application toward the welfare of all, whether employer or employee. Instead of laboring night and day for short periods to meet spasmodic demands, is it not wiser to so adjust the labor so as to bring about the equal distribution of work among the many? Is not the lessening of the hours of labor one of the most vital elements to correct the disturbances between supply and demand?

I submit these thoughts, briefly expressed, as meriting your serious consideration.

The cultivation and maintenance of knowledge and skill on the part of those practicing our art is a question paramount in importance to any that may come before us. The adoption of a wise and uniform system of apprenticeship is a necessity generally admitted and it should receive your careful consideration and action.

Equally important is the adoption of methods that will promote intimate and amicable relations between the employer and employee—the golden rule as a guide will readily suggest practical and effective means for bringing about beneficial results.

The rapid development of mechanic arts in the last decades has demanded and enforced extraordinary efforts on the part of foundrymen to keep apace with the times.

The continued growth in exceptional size, quality and form of foundry products to meet the special purposes intended by the engineer have asserted themselves and compel the application of a knowledge of the sciences far beyond any that our predecessors ever thought of; not only does this apply to the leader, whether superintendent or foreman, but equally to the handicraftsman in all branches of our business.

We are tending more and more toward normal conditions; we begin to understand the causes of and the remedies that apply to existing evils and having faith in our country and its people, look forward to the future, convinced that we will pass through the evolution now in process, with renewed strength, wiser through the experiences of the past."

The Chairman. We are now ready to hear the Secretary.

SECRETARY'S REPORT.

"In submitting to you for your consideration this, the first report from a Secretary of this Association, it might not be inappropriate to briefly review some of the influences that have had an important bearing on the work of the organization during the past year.

Instituted May 12th, 1896, your officers had not more than commenced the work of pushing the Association's claims for recognition among the foundries of America, than we were landed into the midst of a political campaign that so entirely absorbed the attention of America's manufacturers and business men that it was simply a waste of time, and besides was apt to do us more harm than good were we to inaugurate an active canvass for membership among the foundries of this country.

Following upon the heels of the election and its disturbing influences the holiday season seemed to suggest that it would be inappropriate to attempt very much in that line, yet we have

since about December 1st, done our best to test the sentiment of those eligible to membership, in order that the work of the Association might be undertaken in a more intelligent manner.

Until the task of securing a certain membership had been successfully concluded, it was impossible for the Executive Board of the Association to undertake any active work along the line laid down at the time of its formation.

It seemed to be the consensus of opinion at our meeting last year that if we succeeded in getting 250 or possibly 300 members during the first year that we would be accomplishing much. It may be of interest, therefore, to state that despite the unprecedented commercial depression that seems to have cast such a severe blight over our whole country, we have been successful beyond our most sanguine expectations.

We have only found a very small portion of the period that has elapsed since our first meeting as available for the work of organization, yet we have succeeded in the face of the most discouraging difficulties in securing applications for membership from 486 members, and there are fully as many more who have written to say that in the event of the Association's becoming a success or the return of prosperity to the manufacturing interests, they would gladly affiliate with us.

It would seem as if the great bulk of those to whom we should naturally look for support in a movement of this sort have their eyes upon this meeting, and have reserved their final decisions as to whether they will join with us or not until they have an opportunity of judging of the character of the work we may undertake.

The society is now one year old. It is growing in popular esteem, and its future is in the hands of this Convention. The Secretary has received from dues and subscriptions to the Journal the sum of $2,918. During the year there have been paid out for printing, postage, stenographer, rent, supplies, etc., the sum of $2,240.06, leaving a balance of $677.94 in the treasury.

Two hundred and twenty of those who have applied for and been elected to membership are still in arrears for dues. All our bills are paid up to May 1st, and this Association, in the opinion of its Secretary, has reason to be proud of its record.

President Schumann. If there is no objection the report will be received and filed. Has the Treasurer any report to make?

Treasurer Howard Evans. You have really heard the report of the Treasurer in the report made by Secretary Penton, it is not therefore necessary for me to say more than you have heard.

President Schumann. The reports from committees are now in order. Mr. Pfahler, have you not a report ready from your committee?

Mr. Pfahler. The committee would like to have until to-morrow morning to make their report. Some members of the committee have not yet reached the city, and I therefore should not like to make a report until to-morrow.

The Chairman. Well, there is the Committee on Apprenticeships. Mr. Bell, you are chairman of that committee.

Mr. Bell. The committee has only had an informal meeting as yet, but we have appointed this evening for a meeting in the gentlemen's parlor at the Russell House, at which time and place we wish to receive the suggestions of any of the members on the subject in order that we may get the best views of all interested before compiling our report, and as soon after the meeting as possible we will report to the Convention. This evening at 7 o'clock we are to meet and we shall be pleased to receive the suggestions of any member.

The Chairman. Following out the ideas of Mr. Pfahler and Mr. Bell, of course we realize that the first meeting to-day is a provisional one. We shall actually get to work for the good of the Association to-morrow morning at 10 o'clock in this hall. By that time the committees will have gotten together and their reports will be ready. The next business should be the appointment of a committee for the nomination of officers for the ensuing year. That course would give such a committee a day or two in which to consider matters, which is very necessary. There should likewise be a committee appointed to report on amendments to the Constitution and By-Laws. These are matters open for discussion now.

Mr. Beckett. I move that a committee of five be appointed to nominate officers for the ensuing year.

Mr. Frank. In this connection, I would say that as regards the election of officers it is my opinion that any organization or corporation or any association of any character is best off when competent officers are retained. One year is not sufficient for officers to become thoroughly familiar with the duties of their offices. It appears to me that it would serve the best interests of the Association to continue the present officers. I believe a man should not be deprived of his office until he has shown himself unfit. With that in view, I think some expression of the opinions of members should be forthcoming. While this committee will have power to select names, I believe the sentiment should carry that the officers found competent be retained.

The motion of Mr. Beckett, being put to the meeting, was duly carried.

The Chairman. The committee will probably act on the line of thought suggested, and give it due consideration, and perhaps confer with members before coming to any conclusion. The matter of the Committee on Amendments to the Constitution is now in order.

Mr. Penton. As the gentlemen present seem to be a little bashful in making a motion, I might perhaps make a few suggestions which would tend to bring out some thought and ideas in reference to our present laws. We were formed, as most of us know, in a hurry, in the City of Philadelphia, and our laws were made to provide for an emergency. It was not decided when we went there to form any association, and the particular form that this Association should take was a matter of debate and of difference. We have tried the laws adopted for a year, and there are a number of members who entertain many ideas on the subject, some of them conflicting. I do not believe in all the ideas I have heard expressed, but there are some that are good. It seems to me that this afternoon, while we have the leisure, we have a capital opportunity for those present who have been talk-

ing about what should be done to bring before the convention some of the ideas formulated, for discussion. The committee to be appointed by the President will then have an opportunity to act in harmony with the wishes of this Convention. For instance, one idea gaining currency in some quarters and advocated very earnestly is that it is desirable that we take some action that will bring the National Association and the Local Associations closer together. As it now stands a man may or may not become a member of a local society, and still be in the National Association, or vice versa. There might be some means of working closer together with more harmonious relations between the two. There are many ways in which it can be done. It has been suggested that there should be a sort of graduated membership fee or graduated yearly dues. A person who is a member of the Pittsburg Association say, would only have to pay half the dues to the National Association and vice versa. That is one idea that has been advocated. Another idea is that the National Association should consist entirely of delegates from the various associations. Another idea is that we should not take in members of Local Associations. And another is that we should confine ourselves entirely to members of other associations. Nearly everyone present has some idea on the subject, and that the committee might act with some degree of intelligence perhaps it would be well to bring these ideas before the meeting and that some of those present should discuss them.

Mr. Lanigan. I understood from our Secretary that he had 486 qualified members. Now this is a mighty small representation here for 486 people, mighty small.

Mr. Penton. The membership roll contains 486 names, which I think shows quite a growth.

Mr. Bell. I was about to make a motion, but hesitated to do so, for fear I might get into a trap. I think it is prudent that a committee should be appointed, and I was about to move that the chair appoint it. I wish to say, however, that it is not my wish to promote an amendment to the constitution. The question raised in Philadelphia first was what kind of an organization

should be formed. Should it be one to be formed of Local Associations, or stand independently on its own basis? We did not take cognizance of any Local Associations, but allowed foundrymen from the United States and Canada to join us independently of any other organization. That was the form of our Association. I know of no reason why the form should be changed. I can see wherein there would be a hardship to limit this Association to delegates or representatives of other Associations or to charge more to members who did not belong to any Association than to those who did. There are many founders in this country that are so situated that they cannot belong to any local organization, and I am one of them. It would be a hardship to them if they would have to stand off as a second class on position, and that the best privileges should be enjoyed by their brothers who had greater opportunities. For that reason I do not think it would be well to change the form of our organization to a delegate one after first having adopted independent membership. I enjoy the indulgence of the Association in making these remarks without making the motion to appoint the committee. I prefer the appointment of a committee, as I think it right the Association should take such action as may be seen proper.

The Chairman. I did not know that it was the intention of Mr. Penton to convey the idea that the committee should change the form of the organization. I believe the idea is to correct the constitution, which is the basis of our present organization. Am I correct, Mr. Penton?

Mr. Penton. Yes, sir.

The Chairman. There are a few discrepancies that should be corrected, and the committee would be appointed to do that, not with the view of changing the organization. The object of the committee would be simply to perfect the constitution on its present lines. General business is in order, and I think it would be a good thing to discuss the apprenticeship question. There are many here well informed on that subject, so why not exchange ideas as to the ways, means, and methods applicable to perfect that very important element of our business?

Mr. Groves. I remember, Mr. President, in your introductory remarks, that you drew our attention to the fact that a large number of members did not come to the opening session of these proceedings. Now I certainly think it would have been well if the Committees on Apprenticeship and Defense, which have been appointed for three months, had deliberated by means of correspondence, and had come to this meeting ready with propositions on the two questions. This afternoon our proceedings, are, in an ordinary way, interesting, but would have been infinitely more so if these two questions had been in shape for discussion. If we get through with a desultory discussion only, and have to face another convention next year, when perhaps business will be more pressing, and we shall be having better times, we shall perhaps better stop at home another day. It would have been much better if the committees had been able to give us something to deliberate upon. Now we are depending upon a general conversation. The other would have been the wiser plan.

Mr. Bell. I heard very indistinctly what the gentleman said, but I gather that it was something like a reflection on the Committee on Apprenticeships. I wish to make an explanation. I learned some three months ago that I was appointed a member of the committee to present some scheme or plan to this Association on the subject of apprenticeships. I was informed that a place of meeting with the other members of the committee would be arranged and that I would be informed of it. Later I received a letter from the Secretary, in which he said no meeting would be provided for until the meeting at Detroit, when there would be plenty of time to come together and make a report. We met this morning and had a conversation on the subject and thought it best, after reading such papers as were before us, to hear further from the members of the Association this evening, that we might get the best thought in the Association before presenting a report. We fully apprehended the importance of the question submitted to us. We realize that the line on which the foundry interest is drifting will soon leave us without first-class mechanics, and that we are not educating first-class mechanics in this business;

and that we feel foundrymen themelves are largely to blame for this state of affairs. We wish to present something that will induce the foundrymen throughout the United States to take more careful thought of the industry. We know that no scheme can be presented here that will be at once successful, or that can be put into practice at once. It is only by showing to the Convention the matter of the future of the industry that we can accomplish anything. No plan we can present here will work out the details unless we can have the thorough co-operation of this Association, so that we wish to get the best thoughts first, and we are here to receive information and put it in such form that we can present it for the intelligent consideration of the Association at the earliest possible moment. We are not prepared with a report this afternoon, and I have given you the reason.

The Chairman. I would say also in reply to Mr. Groves that the committee appointed on the apprenticeship matter was made up of gentlemen known for the great interest they have taken in the matter. They are not by any means unprepared, but very modestly and wisely have concluded to get the sense of the Association before they submit any definite plan.

Mr. Beckett. I concur perfectly with Mr. Bell as to the necessity for full discussion and would suggest that this meeting go into committee on the matter, the chairman of the organized committee presiding temporarily. You will probably get more people to discuss it now than you will to-night.

The Chairman. The meeting will then go into committee.

The Secretary. Before this matter is taken up there is one thing I should say, and that is that the Committee on Defense did meet, and were in session on several occasions. They have prepared a report, and it is ready for discussion, but the chairman of the committee has brought up some eminent men who have had great experience along the line they recommend this Association to follow; and on that account they have requested a postponement until to-morrow. I would also announce that through the courtesy of the various telephone companies operating in dif-

ferent parts of the country delegates to this convention have the use of the long distance telephones, at the hours specified, free of charge. And if at any other time you have business of importance you can, through the chairman of the committee, Mr. Russel, have free access to the telephone to any part of the system. I also have an invitation from the Detroit Museum of Art inviting the members of this convention or their ladies to visit the art museum at any time.

The meeting then went into committee.

A general discussion of a very interesting character here ensued in which a number took part concerning the apprenticeship question, and at its close an adjournment was had until the evening.

EVENING SESSION.

Mr. John A. Penton read a paper prepared by Mr. Henry Gretener, entitled "A Modern Foundry in Europe," describing some of the notable features of the largest foundry in Switzerland, operated by Sulzer Brothers at Winterthur.

The paper was illustrated by a large number of stereopticon views showing nearly all of the illustrations given in the accompanying text.

He prefaced the reading of the paper by the statement that it had been originally prepared as an article intended for publication in a trade journal, but it had appeared to be so interesting and valuable that it had been thought advisable to make a paper of it, and with the assistance of lantern slides give those in attendance at the convention a better idea of it than could be obtained in any other way.

A MODERN FOUNDRY IN EUROPE.

By HENRY GRETENER.

Probably at no previous time have such rapid strides been made in the improvement of existing foundry practice as during the last ten or fifteen years, owing to the fierce competition in every branch of the business which make it imperative that the largest amount of work shall be produced in the cheapest possible manner. In very many cases exacting demands are made, not only with regard to the quantity, but also with the object of bettering the quality of the output, and this condition of things has called for a number of improved devices, such as quick-acting cranes, machines for conveniently handling the sand, equipments for drying molds and cores, for cleaning castings, etc. The management of the cupola too, has received its share of attention. The Trade Journals have given their readers a pretty good idea of how these things are done in the various foundries throughout the States and, though the children of Brother Jonathan are very apt to consider themselves "The People" it may still be of interest to some of them to find out what people on the other side of the big pond are doing.

The foundry under consideration is the largest one in Switzerland and its origin dates back to the early thirties, when it was founded in Winterthur by two brothers named Sulzer. It gradually grew, along with the machine shop attached to it, until at the present time the establishment gives work to about 2,700 men, not counting the branch houses, which have been started at Ludwigshofen in Germany and in Bruenn, Austria. In the course of years the foundry was removed from the old place to make room for the machine shop and is now located principally in two comparatively new buildings, one for the large work and one for the small work. Each one of these buildings has from time to time been enlarged, especially the former, the latest addition to which is constructed on what is now considered the best

plan in that country. It is the intention of the writer to give in the following a description of the plan and general arrangement of these two buildings and their special features.

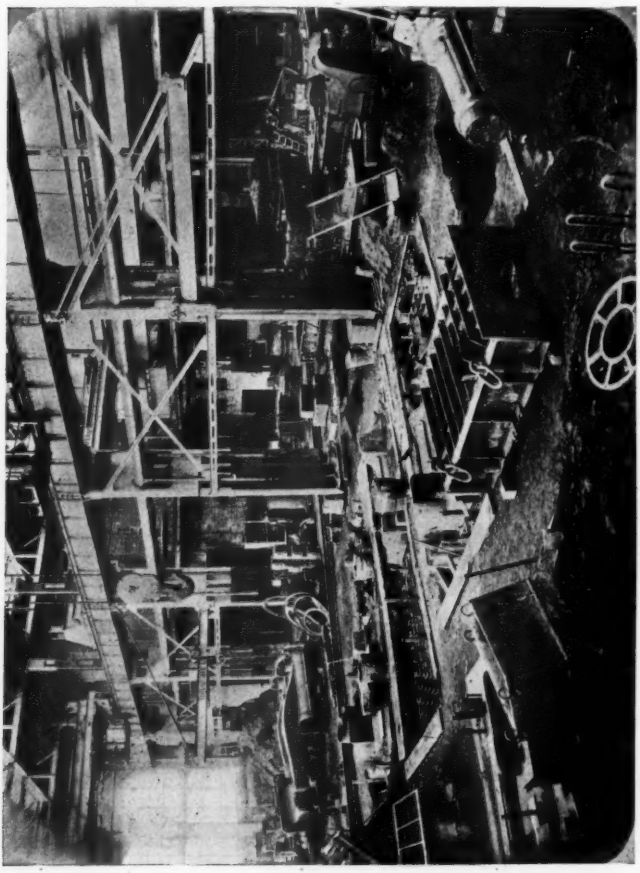


FIG. 1—HEAVY WORK FOUNDRY, SHOWING FORM OF ROOF CONSTRUCTION.

The foundry for heavy work is now a structure 482 feet long and 174 feet wide, measured over the widest part, inside the walls. The latest addition to it consists of two bays, each 51 feet wide. This part of the building will be of special interest, since it

deviates considerably in its construction from the designs usually seen in the States, especially in its roof construction, which is entirely flat with the exception of the skylights. The latter run parallel with the bay, as shown in Fig. 2. The roof construction has now been used in other places for a number of years and has given entire satisfaction. There is not much chance for dust to hang up and darken the roof and it is really remarkable how very light this part of the building is compared with the older shed construction, in spite of the frequent cleanings the latter receives in this shop. There is also much more headroom left for cranes. The roof itself is made as follows: Deep girders made of angles and flat iron, reaching from column to column across the track of the travelling cranes, support I beams that run parallel with the track. These I beams are placed at a distance of 8 feet 6⅜ inches, center to center, and are inclined about 4 degrees towards both sides from the three columns standing nearest to one side of the central railroad track. This gives a like inclination for the roof in the direction of the crane tracks, in which way proper drainage is secured for the otherwise flat surface. Over the whole length of the I beams are fastened timbers, to which are nailed 3-inch boards. On top of the boards is first placed a thin layer of sand, then one layer of what is called "carton pierce for roofing," a kind of tar paper covered with sawdust. Over this a composition something like tar (in German called "Holz-Cement"—wood-cement) is applied with a brush. Then follows one layer of common paper, which in turn receives a coat of this wood-cement. Again a thickness of common paper with a coat of wood-cement is put on. On top of this follows another layer of carton-pierce and then about ¾-inch of sand, and finally 3 inches of gravel. The gravel and sand in themselves form a protection against fire and the wood-cement is prepared in such a manner that it will not burn. The construction of the skylights is shown in Fig. 2 A. The glass is placed between two T irons in each pane, the lower ends of the flange being turned up to hold the glass from sliding down; A forms a continuous gutter of sheet iron to catch any water that may condense on the inside of the glass roof in cold weather.

Another piece of sheet iron covers the top and outside of the beams supporting the skylight and reaches about 8 inches be-

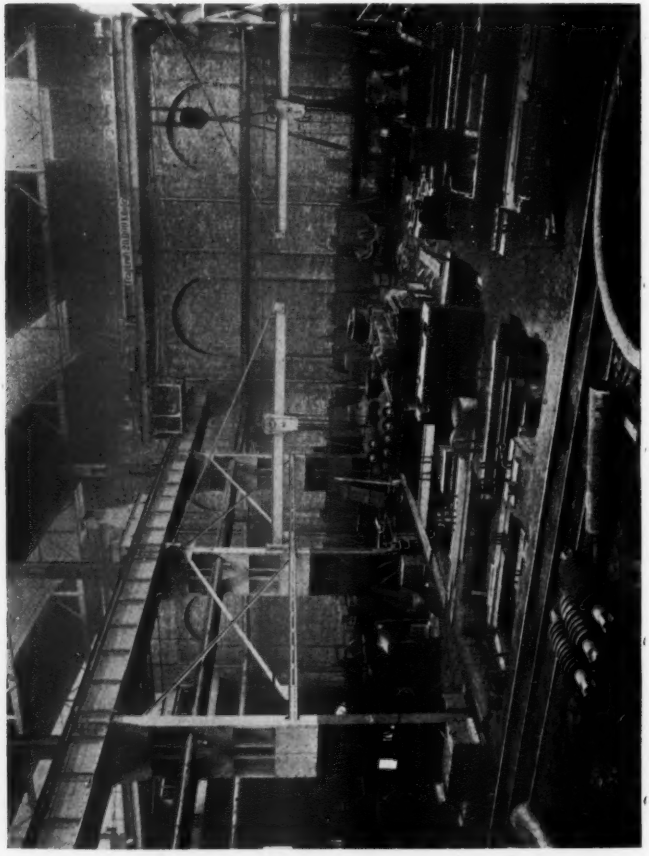


FIG. 2—ANOTHER VIEW OF HEAVY WORK FOUNDRY, SHOWING COLUMN JIB CRANES AND HOT BLAST PIPES FOR DRYING MOLDS.

tween the lower thickness of carton pierce and the first layer of paper, so as to prevent any water from coming in contact with the woodwork. This is shown at B.

Between the three rows of columns of this new addition are located the run ways for two 20-ton cranes in one bay and one 25-ton and one 12½-ton crane in the other bay. They are all electric cranes on the one motor alternating current system. The motors are 13 horsepower on each crane. Following is the table of speeds for the various operations:

Capacity of Crane.	25-ton.	20-ton.	12½-ton (a 2,200 lbs.)
Speed for lifting the full load	3 ft. 2 ins.	3 ft. 11 ins.	6 ft. 6¾ ins.
Speed for lifting half the load	6 ft. 3 ins.	7 ft. 10 ins.	13 ft. 1 in.
Speed for racking carriage	19 ft. 0	24 ft. 6 ins.	39 ft. 5 ins.
Speed for travelling	82 ft. 0	82 ft. 0	82 ft. 0

The greater speed for lifting light loads is effected by throwing in other gears. The span from rail to rail is 47 ft. 6 ins., the distance from floor to rail top of crane track 26 ft. 3 ins. Instead of using chains these cranes have all been built for wire ropes (1⅛ in. diameter on 25-ton crane), which gives a much smoother motion in lifting than is possible with a chain, an important point in foundry work. Ropes have the further advantage that if they break, they do not go without warning like a chain. The hooks all turn on ball bearings, with balls about 5-8 inch diameter, which run on hardened steel plates, the latter having circular grooves turned for the balls to run in. The track for the cranes is made of plate girders with double webb 3 ft. 1½ ins. deep. The rails are about 100 lbs. per yard, bolted at short intervals to cast iron plates, which in turn are bolted to the top of the plate girders. The columns supporting the latter are 22 ft. 11½ ins. apart, and on every second one is also placed a light jib crane with a jib 25 ft. 9 ins. long, carrying a 3-ton chain hoist of very good design. Each of these jib cranes serves the nearest two floors; they can be plainly seen in Figs. 1 and 2. The large galvanized iron pipes seen all along the walls and sides belong to the system of hot blast, which is so extensively and

successfully used by this concern for drying the large moulds, where the drag part is formed in the floor. At the time the photos were taken the new pipes were just being put in place throughout the building, as the old system was found to be too small in diameter. At short intervals branches are seen in the main pipe

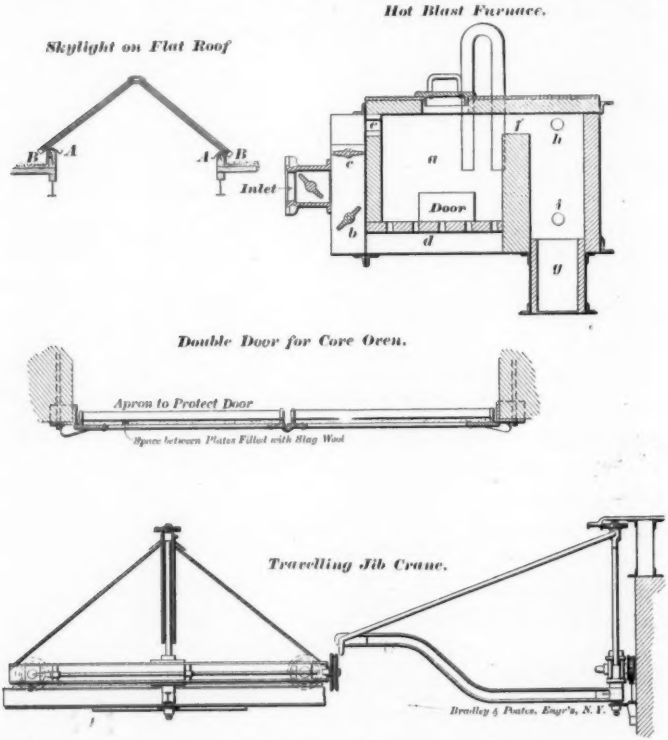


FIG. 2 A—CONSTRUCTION OF SKYLIGHTS—SECTIONAL VIEW OF HOT BLAST FURNACE—CONSTRUCTION OF CORE OVEN DOORS—TRAVELING JIB CRANES.

running down to the floor, from where connections can be made by movable pipe sections to the furnaces, which are placed on the cope after the latter is set over the drag part of the mould. (In Fig. 1 some of these vertical pipes are shown, while in

other places short branches from the main pipe only are seen, the connections not being finished yet.) It must be mentioned that, when using the hot blast furnaces, the copes are not closed down over the drags, but raised up a little, generally to the depth of I beams that are set all around the mold, to support the flask of the cope. The joints and openings left are closed with a little loam, to prevent the heat from going out too quickly. A section through such a hot blast furnace is shown in Fig. 2 A. Their operation is as follows: The fuel is placed in the space "a," the valve "b" opened and valve "c" closed, so that the cold blast from the admission pipe goes through the grate "d" and the fuel until the coke is well burnt through. Then valve "b" is almost closed and valve "c" fully opened, so that now most of the blast goes over the bridge "e," over the white hot fuel in space "a" and over the bridge "f" into tube "g," which connects to inside of mold, either through the risers, or through holes that are filled in again after the mold is dryed. The two holes "h" and "i" on the side are closed with plugs that can be taken out to see whether any flame is coming over the bridge "f," in which case valve "c" would have to be closed partly. The pipes of this system, leading along the wall, form one continuous circuit or an endless pipe line, acting as one reservoir for the blast, which is furnished by a special fan. The diameter of the main pipe is 24 ins. through a considerable part of the building, that of the admission pipe to the furnaces is 3 ins. The whole pipe line is very well made, with large bends, so as to offer the least possible resistance to the flow of the air.

In the rear of Fig. 1, in the second bay, are seen two ovens. The larger one is 26 ft. 3 ins. long by 16 ft. 1 in. wide, the other of the same length, but only 5 ft. wide. Both are 11 ft. 10 ins. high and built to receive any work that requires drying in ovens, the latter specially for drying molds for turbine shafts. In front of the ovens, a little to their right, are located two gear molding machines for making spur and bevel gears. They are both of the type designed by Mr. Rothwell Jackson in the fifties, where the mold is revolved on a circular table, and a segment with a few teeth that serve as pattern, carried on an overhanging

arm. The latter slides on a horizontal bed, so as to be adjusted to any diameter within the range of the machine, which is up to 9 ft. diameter. To one of the machines can be attached a rig carrying an arbor with a single milling tool, with which it is possible to cut the pattern segment on the machine itself. The cutter

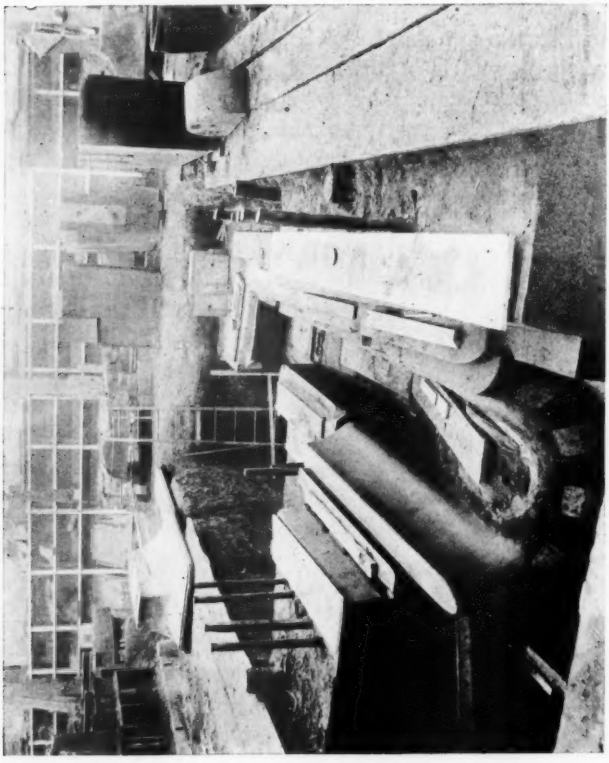


FIG. 3—MOLD FOR ENGINE FRAME.

makes about a thousand revolutions per minute. For cutting both gears the cutter has the same shape as the small end of the teeth, the large end has to be dressed by hand afterwards. In this machine are also cut those complete gears that have wooden cogs.

The principal work so far done in this new section are on the side shown in Fig. 2, the heavy engine frames. The largest one of those made in one part, weighs 15 tons @ 2,200 lbs. Fig. 3 shows such a mold in course of construction. The other side will be used for other heavy pieces, such as frames for ice machines, condensers, etc. (At the time of writing the large castings were cleaned in the latter space, because the new cleaning room was not quite completed yet.) At present there are six engine frames of various sizes on the floor continuously. As soon as one is cast, another one goes in. The ladles with the iron, as well as any other material, is brought to this section of the foundry on cars, that run on a railroad track, both standard and narrow gauge in the center across the two bays.

The older part of the building in which the cupolas are located, is constructed in a different manner. The roof is of the shed type. There are three tracks for cranes, that run at right angles to those in the new part. The cranes are run with a rope drive. Two of the tracks have three cranes each of 20 tons capacity and 35 ft. 9 ins. span, while the last track, which is not as long as the others, has but two, also of 20 tons capacity, but 47 ft. 9 ins. span. All these cranes use either the Gall link chain, or the ordinary pitch chain. Under the two long tracks are located two movable jib cranes, running on one I beam fastened with overhanging arms just below the crane track, and one rail further down as shown in Fig. 2 A and Figs. 3 and 4, with a jib 13 ft. 2 ins. in length, carrying a chain hoist of 2 tons capacity. These cranes, though they are now operated by hand, have proved to be very efficient, and it is intended to run them by electricity later on. Fig. 4 gives a general view of this part of the building, where most of the molding is done in the floor, with sweeps, in green sand, and without patterns. In this manner are molded all kinds of fly wheels, rope pulleys, small turbines, large pistons, etc. But all these molds must be carefully dried afterwards owing to the composition of the sand that is found in that part of Europe, and which contains a good deal of a loam. Fig. 5 shows such a mold of part of a fly wheel and rope pulley combined, which is cast in four sections, that is,

the halfs are each cast in two pieces of half the rim width, that are afterwards bolted together. The diameter is 18 ft. 4½ ins., the total weight of the whole wheel will be something over 50,000 lbs. It ought to be mentioned here that the grooves for the ropes

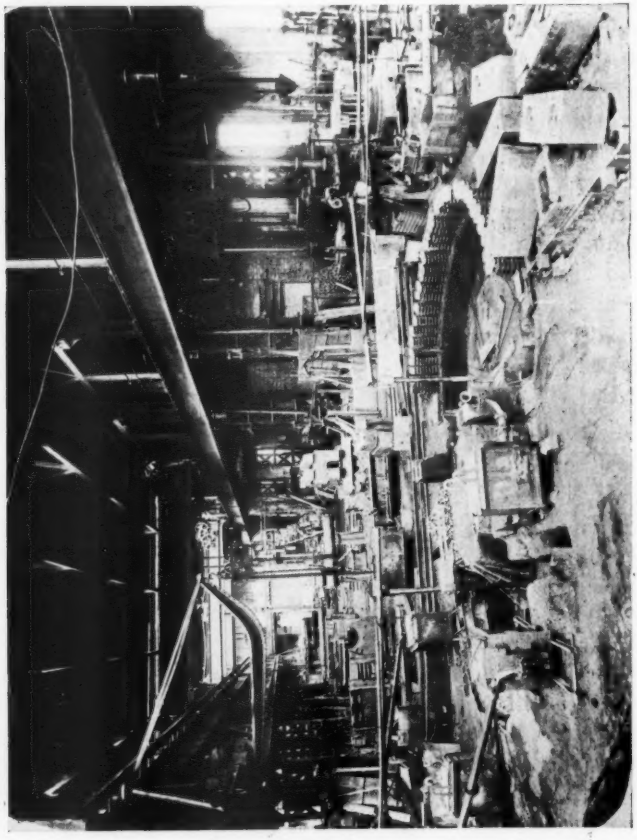


FIG. 4—GENERAL VIEW OF THE HEAVY WORK FOUNDRY, SHOWING TRAVELING JIB CRANE.

are swept up in loam instead of sand, the rest in sand. The part inside the rim is made in such a manner that it can be lifted out. (In wheels with but one set of arms, as shown in the mold to

the right in Fig. 5, the parting is made in the center of the arm thickness, and the upper part is then rammed up in a flash. In wheels with two sets of arms of course the process must be somewhat different. The arms are also made with a sweep.) The parts that are lifted out, are dried separately in large ovens built for that purpose. Some of them are too large for the ovens, however. If this is the case, they are put down in a square pit 23 ft. 8 ins. by 15 ft. 5 ins., and about 9 ft. deep. This pit is then covered over with two large pieces of corrugated iron that turn on hinges, and used as a drying oven. There is a round hole dug down from the bottom of this pit, which was used up to the present time to receive flasks in which hollow turbine shafts up to 24 ft. in length are cast on end. The heaviest ones weigh $7\frac{1}{2}$ tons and the shaft with flask and sand about 25 tons. On account of this heavy weight, however, the casting of these shafts is now to be transferred to the new building under the 25-ton crane, where a similar pit has been built for the purpose.

Fig. 6 shows a large gear molding machine with a spur gear of very coarse pitch just being molded on it. The largest work, that this machine will do, is 18 ft. diameter. In the same figure, somewhat to the right, appears part of a machine, on which cores are turned on centers. It resembles a lathe, but has a large hand wheel on the rear of the head stock for driving, with two sets of gearing for turning large or small cores, similar to the back gear of a lathe head stock.

In the foreground of Fig. 7 is seen an arrangement by which the two parts of fly wheels, that are cast in halfs, can be made with one and the same sweep, from the same center. On the surface of the cast iron plate, on which the pivot shaft stands, is cast a cam, the shape of which pretty nearly approaches two circular grooves with centers as far apart as the distance between the centers of the two halfs of the fly wheel (see Fig. 7 A). A roller is guided in the cam groove and is attached to the slide carrying the sweep on its outer end. This slide is moving in and out on an arm that is revolved round the central pivot, the sliding motion, of course, being produced by the roller following the

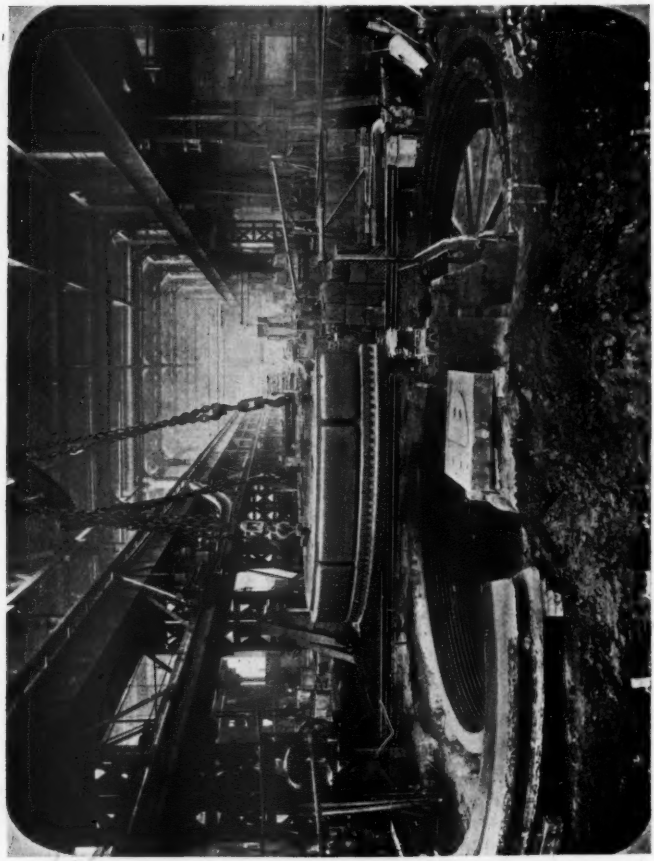


FIG. 5—MOLD OF FLY WHEEL AND ROPE PULLEY COMBINED—WEIGHT, WHEN FINISHED, 50,000 POUNDS.

groove, which is not concentric around the mast. The shape of the groove ought to be such, that the sweep describes two true half circles with centers the above mentioned distance apart. This distance between the centers of the fly wheel halves is selected by the designs according to the requirements of the work, when laying out the cam groove. Absolute accuracy of the circles

described by the sweep can only be attained for one size wheel with this arrangement, and therefore the groove is constructed for a medium size, but the variations for larger and smaller diameters are so small that they can be neglected altogether. A core is set on each side between the two ends of the rim of a thickness equal to the distance between the two centers, less the allowance for finish. A similar core separates the two halves of the hub. These molds are swept up in sand and owing to the large floor room taken up by a wheel molded in this way, anything above 13 ft. diameter is made one half at a time. A machine like the one just described, but of smaller dimensions is seen in operation in the second mold from the front.

Fig. 7 gives a general view of the part of the foundry where mostly loam work and the necessary cores are made, while Figs. 8 and 9 show details. Fig. 8 is a complete mold for a large turbine with a double ring of buckets. Steel blades are used in the inner ring and cast iron blades on the outer one. To the right is shown the ring with the steel blades. The latter are part in position and rammed up with sand between, the whole resting on a heavy plate on brackets. The steel blades are tinned at the projecting ends so as to unite firmly with the hot metal. In the middle of the figure is visible the outer row of cores for the cast iron blades. To the left is shown the small center piece all ready to go inside the inner row. In the rear, also to the left, is shown a row of cores that are being dried, and to the right are seen two of the hot blast furnaces before mentioned. They are placed on top of a mold, with the connections made to the pipe line.

Fig. 9 shows the parts of a cylinder mold for one of the well known Sulzer engines. Most of these cylinders are cast with an outer and inner wall enclosing a complete steam jacket. The largest ones, however, have a separate bushing, which, together with the cylinder casting forms the jacket. The heaviest ones of the latter kind weigh about 20 tons. They are cast at the rate of about 20 a month in loam (the smallest ones are made with patterns, and the latter included they cast one every day). After the cylinder molds are dried they are put in one

of the five pits built for the purpose. These pits are all surrounded with brick walls and are not rammed up with sand before pouring. Instead of that several courses of plate are put round the mold, like a circular shell, each course consisting of a number of segments that are bolted together. For the lowest course stronger plate is used on account of the heavy pressure the

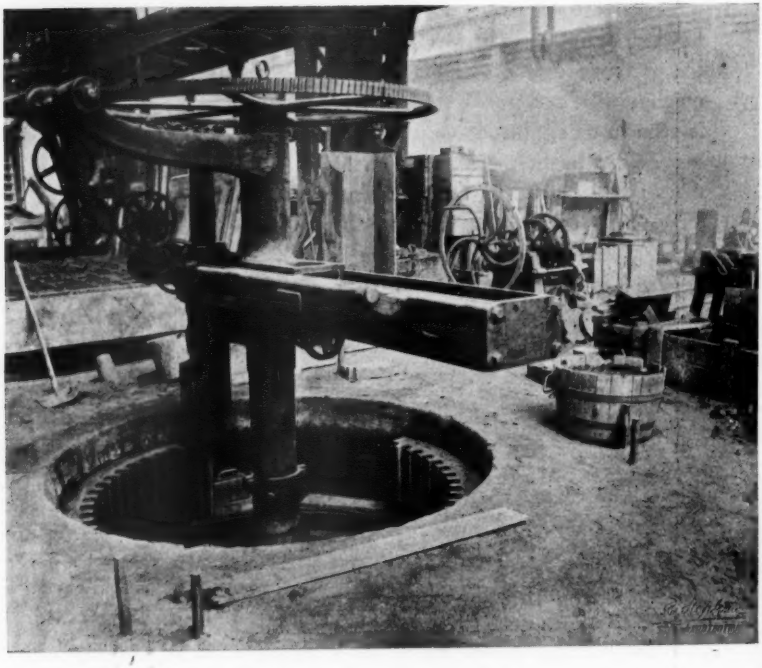


FIG. 6—GEAR MOLDING MACHINE.

iron exerts against the lower part. For the same reason this first course usually consists of two rings. The inner one is first put up, leaving enough space inside the plates in order that it can be conveniently rammed up with sand. After that the outer ring is also set up and rammed. On top of the outer ring follow the other courses, each one in succession being rammed

up. This arrangement naturally saves a great deal of work in getting the pit ready again for another cylinder, as the plate can be taken off a few hours after casting and only the brick walls remain standing round the casting for one or two days, according to the size of the cylinder.

For work of this class the drying ovens must naturally be of a corresponding size, as well as the cars on which the work is brought to the oven. At the rear, in Figs. 8 and 9, are seen several of them, all of the same dimensions, viz.: 23 ft. long by 19 ft. 8 ins. wide by 13 ft. 2 ins. high. The firing is mostly done in two or four holes in the floor. The grates are accessible by means of an underground passage. The roofs are formed with I beams and brick arches between in a very substantial manner. The doors are all double, some made of corrugated iron and some of the flat plates with cast iron frames. The space between the outer and inner plates is filled with slag-wool, to prevent the heat from going through. A third plate is usually fastened to the inside, reaching three or four feet up from the ground, so that the door itself does not catch the full heat from the furnace holes. Fig. 2A shows a section of such a door. All drying ovens in the loam foundry have doors that are raised up vertically, and their roof is about level with the sand-mixing room, located in the rear on the second floor, so that it can be used for drying sand.

The next sketch, Fig. 9A, shows a large core oven car made of I beams with cast iron brackets put loose between, so that they can be moved about at will. For such a large car it has been found, however, that the action of the heat warps the I beams out of shape. They intend to try one of cast iron, with some kind of a roller bearing in all the 22 journals. When these cars are fully loaded they have to carry thirty tons and more. One of them is shown in Fig. 9. The part, standing directly over the fire, when in the oven, is lined with fire brick. This lining is visible on car front in illustration. It will be noticed that the lower seven 10 in. beams are very close to the ground. This is to give as much height as possible from top of car to roof of oven and yet the largest cylinder molds are too high to go in

the oven, and therefore dried in the pit. Figs. 10 and 11 11 give general views of the loam foundry in the front and the green sand moulding in the distance. These views are taken from the top of the drying ovens, behind which are located

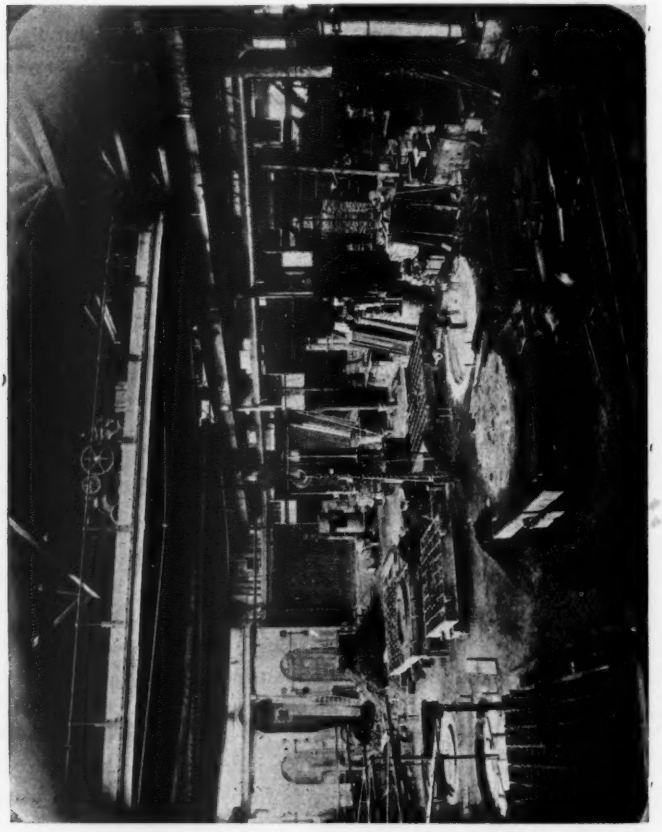


FIG. 7—ARRANGEMENT FOR MOLDING TWO PARTS OF FLY WHEELS FROM THE SAME SWEEP AND THE SAME CENTER.

the sand chambers or sand magazines in the basement, in which a great deal of the winter's supply can be stored away, and on the second floor above them, as already mentioned, is the sand

and loam mixing room. This department is arranged very much like the one in the foundry for light work, which latter shows so many features of interest that it will be described and illustrated separately later on.

Fig. 12 shows three of the four cupolas standing in the middle of the total length of the building. The platform is 17 ft. 9 ins. from the floor level, and near the wall it has an hydraulic elevator of 2 tons capacity, working under 90 to 95 lbs. water pressure. Since these cupolas differ considerably from the designs usually met with in America, it will be of interest to have some further details regarding them. A receiver directly con-

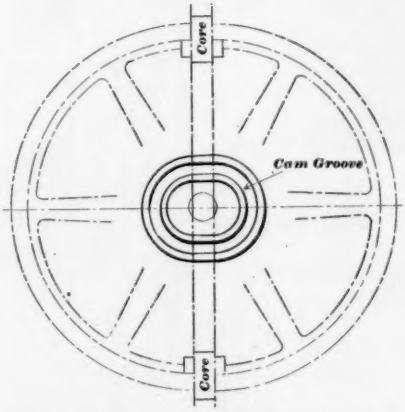


FIG 7 A—SHOWING ARRANGEMENT EMPLOYED IN MAKING SPLIT WHEELS FROM ONE CENTER.

nected to the stack by means of a short socket, is used with every one of these cupolas. The bottom of the main stack has a drop door, the same as is usual in America. In some cases the bottom plate is inclined so that the sand bed can be made the same thickness all over. Just below the charging door a cast iron ring is set in the lining so as to protect the bricks, when throwing in the charges. The lining tapers down to a point just above the tuyeres. The kind of bricks used are the standard arch bricks 3x4½x9 ins., no large cupola blocks at all. The receiver

is arched over on top, and has an opening covered over with a ball, that can be raised from its seat by means of a lever so as to give vent for the gases from time to time. There are two distinct types of cupola used in the shop, with regard to the arrangement of tuyeres. The one is the "Rapid," Stuart's patent.

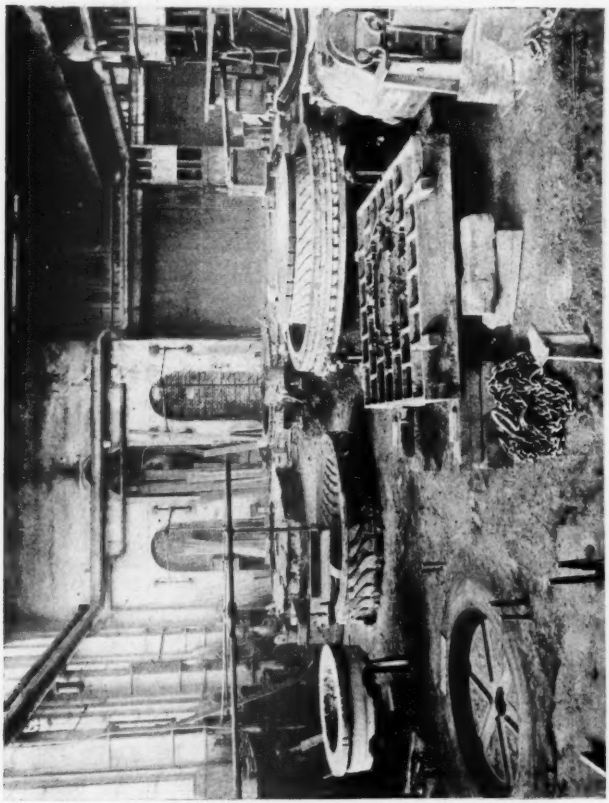


FIG. 8—COMPLETE MOLD FOR LARGE TURBINE WITH A DOUBLE ROW OF BUCKETS.

with three rows of tuyeres, the other is an old Ireland type with two rows, but provided with a receiver. I will give the principal dimensions of one of each type.

First. "Rapid": Diameter of shell, 5 ft. $\frac{1}{2}$ in.; diameter at tuyeres, inside lining, 2 ft. 8 ins.; diameter below charging door, 3

ft. 10 ins.; above charging door, 4 ft. 3 ins.; distance from center of lower tuyere to sand bed, 20 ins.; diameter of three lower tuyeres, 5 ins. each; distance from center of lower tuyere to center of middle tuyere, 11¾ ins; diameter of three middle tuyeres each 4 ins.; distance from center of middle tuyere to center of upper tuyere, 11¾ ins.; diameter of upper three tuyeres, 3 ins. each. All three rows of tuyeres have one common windbox on the outside of the stack. The lower tuyeres are inclined up towards the center, the upper tuyeres slope down and the latter can be shut off entirely. The diameter inside of lining of receiver is 4 ft. 5 ins. The opening from stack to receiver is not less than 10 ins. high and 5 ins. wide. The receiver itself can hold as much as seven or eight tons of iron. Over the hole in the receiver shell, which is cut out for tapping, and which is about 16 ins. wide by 18 ins. high to admit a man, is wedged a plate cover with a small opening for the tap hole. The hole in the lining of the receiver is formed by leaving a small space between two bricks. A cone-shaped plug is pushed in the clearance left thus and fire clay pressed all round, the plug to make a smooth hole. The actual melting capacity of this cupola is seven to eight tons per hour, with a blast pressure of 15 oz. or 25½ ins. water column.

Second. "Ireland": Diameter of stack is 6 ft. 1½ ins.; diameter inside of lining at tuyeres, 2 ft. 9½ ins.; diameter below charging door, 3 ft. 11¼ ins. This cupola has only got two rows of tuyeres, the lower ones, four in number and 7 ins. diameter, are 20 ins. from the sand bed; from center of lower tuyeres to center of upper tuyeres, 17¾ ins. There are eight tuyeres in the upper row, of 2⅜ ins. diameter. Both upper and lower tuyeres go horizontally through the lining. The wind box on this cupola is inside the stack covered over with the lining. The capacity of this cupola is 8 tons per hour. The charges are as a rule 133 lbs. of coke and 2,203 lbs. of iron. The bed fuel on an average is 1,545 lbs. of coke. The receiver on both cupolas has a slag hole to one side, which, however, is only used during very large heats. The above data are taken from one of the daily melting sheets of the concern and are absolutely correct.

The blast for the cupolas is furnished by a Root's blower, made in England, which runs at about 800 revolutions per minute and by a fan running at 1,500 revolutions, of the firm's own make, this being one of their specialties. The Root's blower only furnishes blast enough for one cupola, as soon as two cupolas are running together, the fan has to be started, to assist the blower.

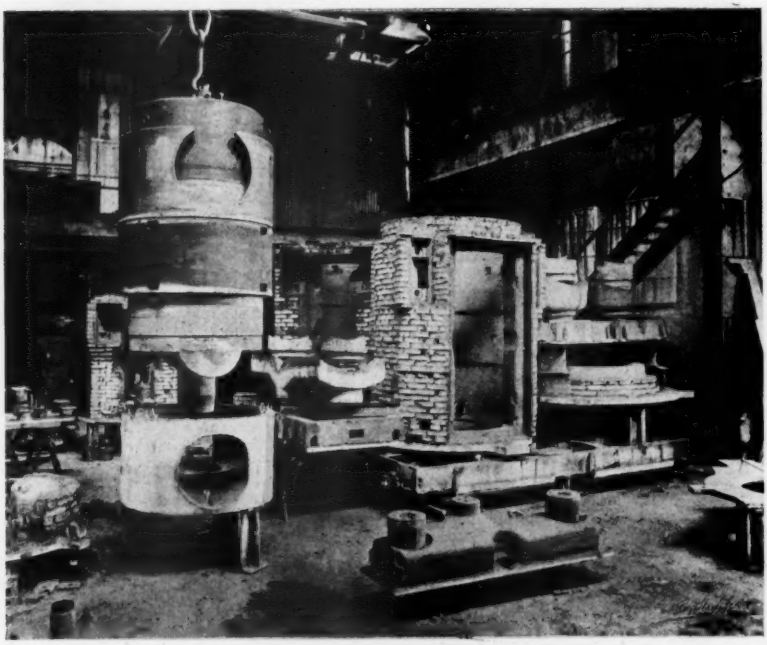


FIG. 9—PARTS OF A CYLINDER MOLD FOR A SULZER ENGINE. (CAST WITH STEAM JACKET.)

These two machines are blowing into the same mainpipe and are placed in a separate room under the cupola platform where they are driven by a Ball & Wood engine, purchased in New York.

Near the cupolas, but separated from the main building by a wall with a very large door in it, is the new cleaning room for

the heavy castings, 128 ft. long with a travelling crane of 40 ft. span running the entire length. In the center of this room runs an underground channel 9 ft. 10 ins. deep, built in concrete. At one end of the room it is about 6 ft. 6 ins. wide, at the other end 10 ft. 10 ins. At intervals of 12 ft. it has branches running off at right angles, which open through the floor, covered over with grid irons. At the large end of this channel is located a propeller shaped fan on a horizontal shaft, which, in revolving, draws air through the grid irons into the channel and through the fan into a vertical shaft in one corner, leading through the roof. This current of air also takes the fine dust out of the cleaning room, thus adding largely to the comfort of the men employed in this part of the building. The vertical shaft, instead of going straight up through the roof, has a bend in it, leading on top of the two drying ovens previously mentioned in the new addition. There a sprinkling arrangement, consisting of five sprinklers of novel design, is placed in such a position, that the whole cross section of the shaft is filled with the fine vapor produced by the sprinklers. In this way it is expected to settle all the dust in the bend of the shaft, instead of throwing it out on the roof. The sprinkler part of the dust extricating plant was just being put in at the time of writing and had not yet been tested.

Before going over to the description of the foundry for light work I must not forget to mention the great care with which the large ladles of this concern are fitted up. They are all made very strong, and the worms are all cut on a lathe so as to get a very smooth running gear, which latter is also provided with oil cups on all journals. Outside of the building is located a drop in a closed shed and in another building is the plant for furnishing a power of 250 horsepower for the electric cranes in both foundries and also for the electric lights, of which there are in the shop for large work twenty-four arc lamps at 10 ampheres and ten at 15 ampheres; five in the cleaning room at 10 ampheres, and four in the yard at 10 ampheres. In the foundry for light work they have four lamps at 15 ampheres, fourteen at 10 ampheres, and eleven at 8 ampheres. Two pig iron breakers, one belt driven and the other steam driven, of American make, break the pig iron in lengths of 7 or 8 inches.

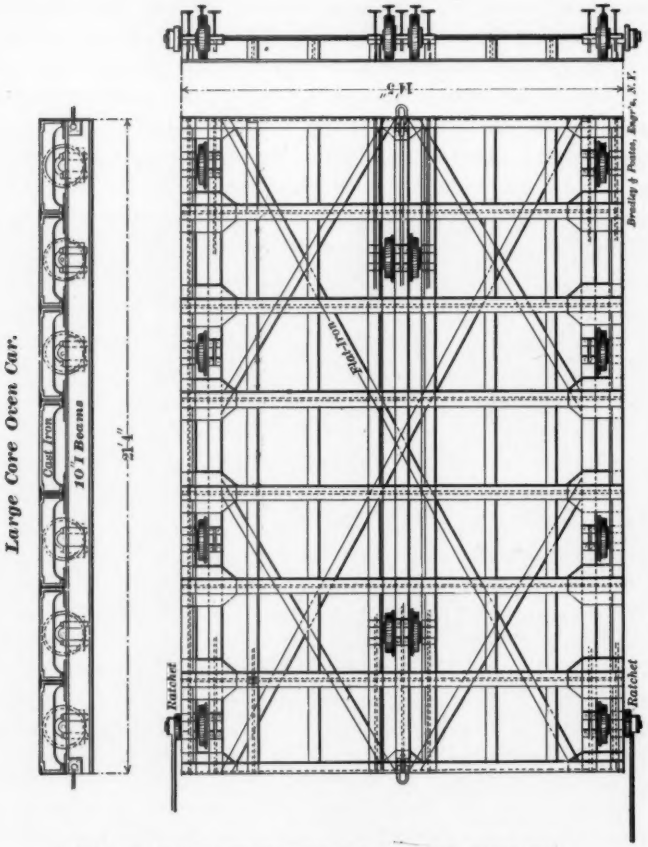


FIG. 9 A—PLAN AND ELEVATION OF CORE OVEN CAR.

The foundry for light work is a building of somewhat irregular shape. Its largest dimensions are 380 ft. long and 160 ft. wide, with an annex built to it, containing the sand chambers in the basement, a large shipping room on the first floor and offices on the second floor. Adjoining the annex, also on the second floor is located the sand mixing room. By far the largest part of this foundry building is covered with the flat roof described at the beginning of this article.

Fig. 13 shows a view of the whole interior. The output consists mostly of radiators, cotton mill machinery, loom work, light steam engine work, etc. To the left is seen the machine molding floor of which a separate view is given in Fig. 14. The machines along the benches (see Fig. 14) are all hand molding machines of uniform design, where the sand is pressed in the flash with a lever arrangement, with the

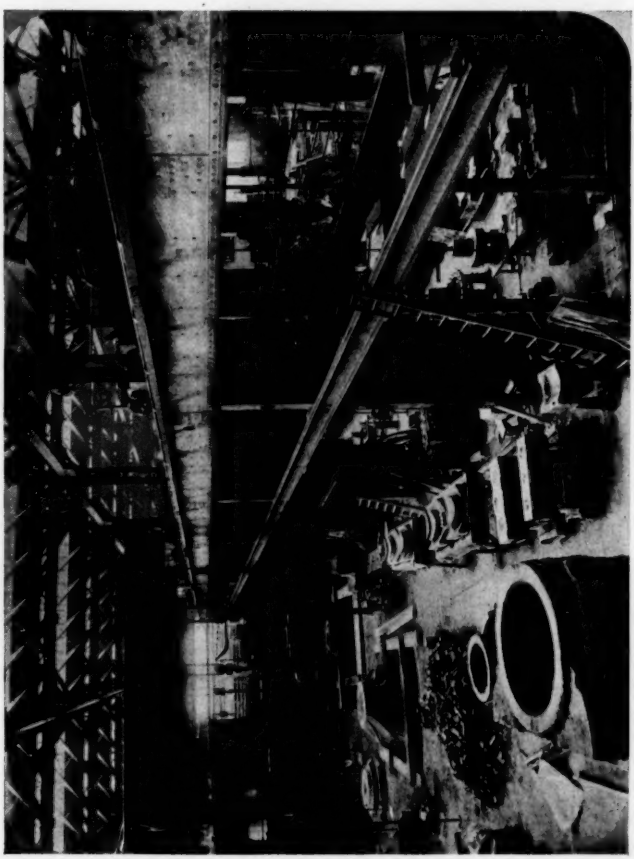


FIG. 10—GENERAL VIEW IN LOAM FOUNDRY.

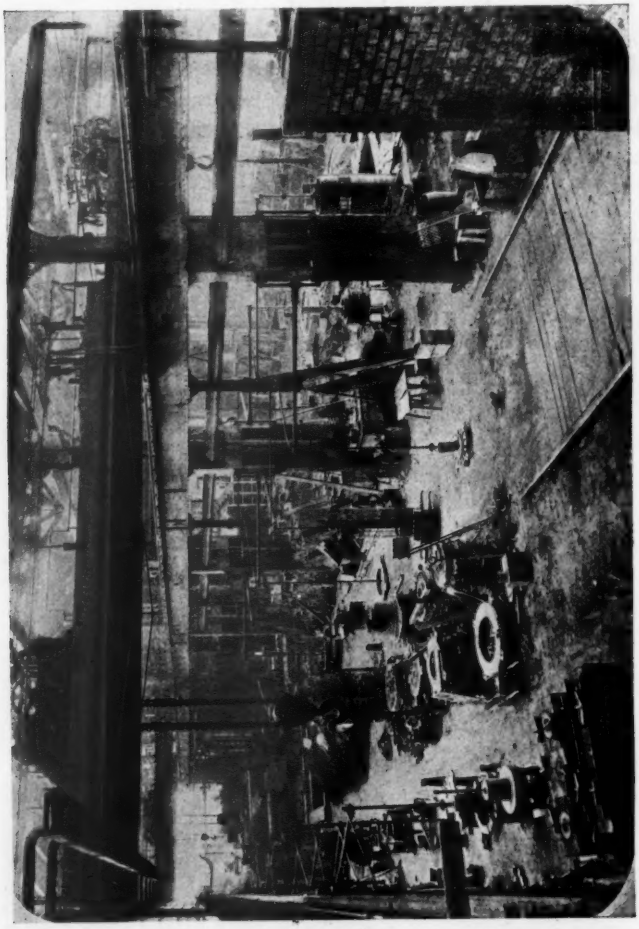


FIG. 11—SAME AS FIG. 10—GREEN SAND DEPARTMENT SHOWN IN THE DISTANCE.

exception of one machine, which is used for making radiators of a shape shown in Fig. 15. The thin ribs are molded with the aid of a stripping plate. The sand is rounded in by hand and then the pattern drawn through the plate. The thick-

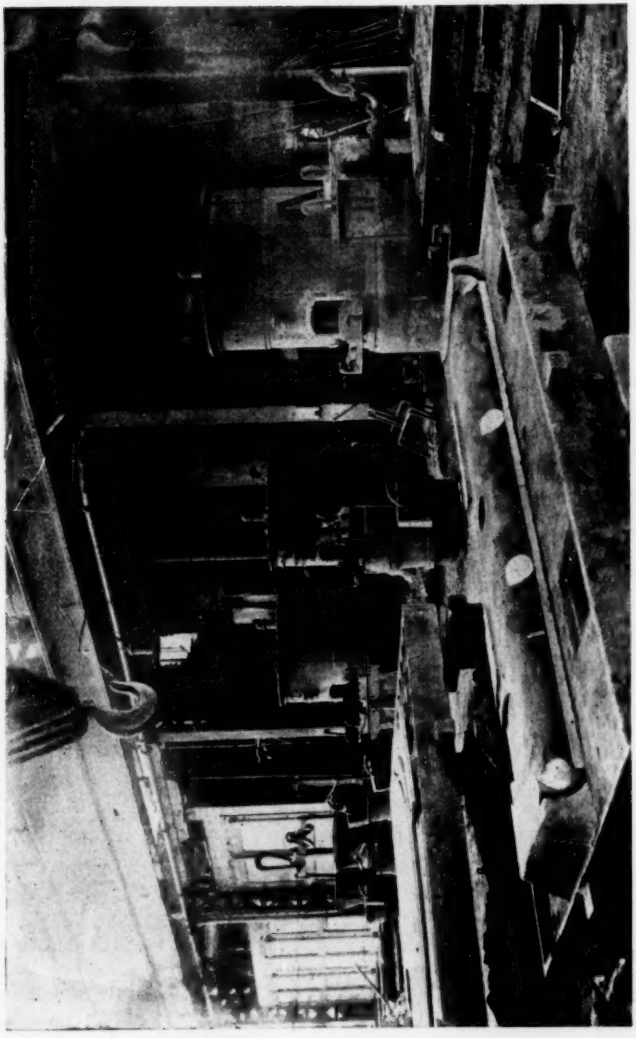


FIG. 12—SOME OF THE CUPOLAS.

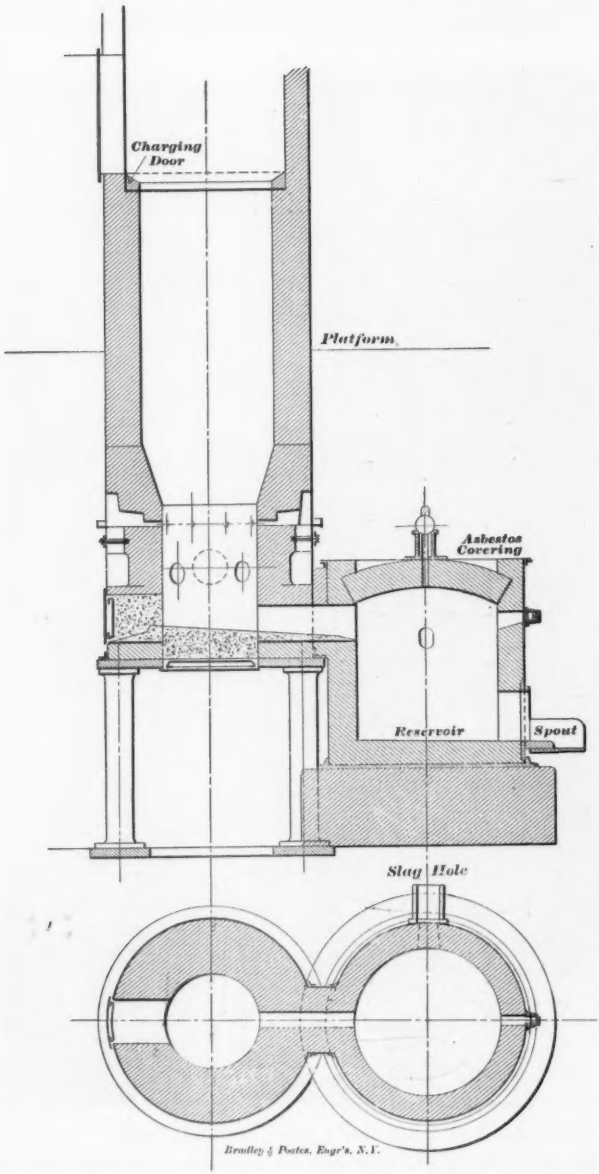


FIG. 12 A—VERTICAL AND HORIZONTAL CROSS SECTIONAL VIEWS OF IRELAND CUPOLA IN SULZER BROS.' FOUNDRY, AT WINTERTHUR, SWITZERLAND, SHOWING RESERVOIR.

ness of the ribs is about 3-32 in. at the top, their depth 1¾ ins. In the rear of Fig. 14 and also partly shown in the left hand corner of Fig. 13, are seen two hydraulic molding machines, used for making radiators and similar work. The

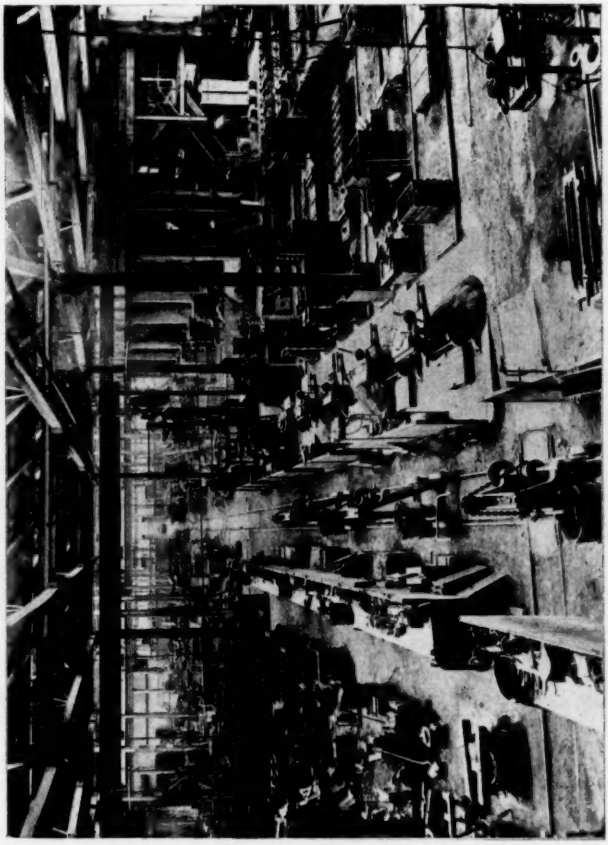


FIG. 13—INTERIOR OF FOUNDRY FOR LIGHT WORK.

piston of these machines is 5¾ ins. diameter, the water pressure 370 lbs. per inch. A track extends on each side of the machine, with one carriage to the right and one to the left, each carrying a pattern. One man fills his flask, runs the carriage under the

machine and after applying the pressure, makes room for the man on the other side. In one corner of the rear wall is seen the accumulator, with which these machines are operated. On the same floor are also located several other molding machines of various designs, one of them electrically driven, made by Aiken & Drummond, in Louisville, Ky. It would lead too far, however, to go much into the details of the construction of any of them.

FIG. 14—HAND MOLDING MACHINES.

To the right in Fig. 13 is shown part of the bench molding floor, where a regular school for apprentices is arranged, for from thirty to forty apprentices under the supervision of a special foreman, as the firm thoroughly believes in the principle of raising their own men. The boys start in the core room from where they go into this department. The time they

have to serve is four years, three of which are spent in the foundry for light work. From there they go, according to their abilities, to the heavy pattern work and molding with the sweep in sand and loam. Each molder has got a small cupboard on his bench, one of which is seen to the left in Fig. 16, in which to keep his small tools. It will be noticed that there are no wooden flasks to be seen anywhere, neither are there any snap flasks used on this floor. In spite of all the efforts made to introduce the

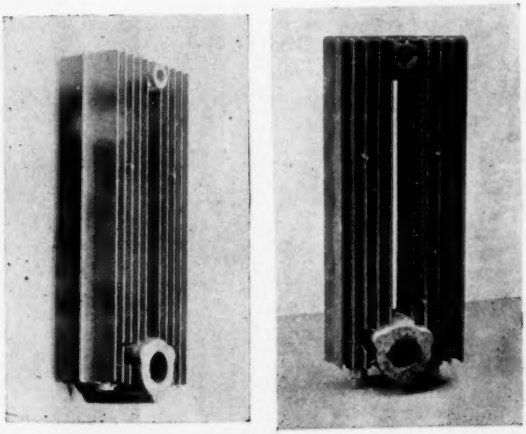


FIG. 15—RADIATORS MADE ON HYDRAULIC MOLDING MACHINE.

latter, of which a number were bought at one time, the men refused to adopt them for reasons not known to the writer.

In the rear of the bench molding floor and on the gallery above the core room is located. There are, besides others, a few of Millett's patent core ovens in use, that were sent over from the States and are giving excellent satisfaction. For making round cores up to 4 ins. diameter and 12 ins. long they use two special machines. Between two side frames is located an adjustable bracket with a vertical rod, on top of which can be screwed a disc of any diameter up to 4 ins. A hand wheel and shaft, placed in the lower part of the frame, have crank pins, to which

are attached connecting rods, carrying on their upper ends a movable plate, also guided in the frames, in the center of which can be set bushings with a bore up to 4 ins. For making a core, the plate is raised up, until the distance from the top of it to the

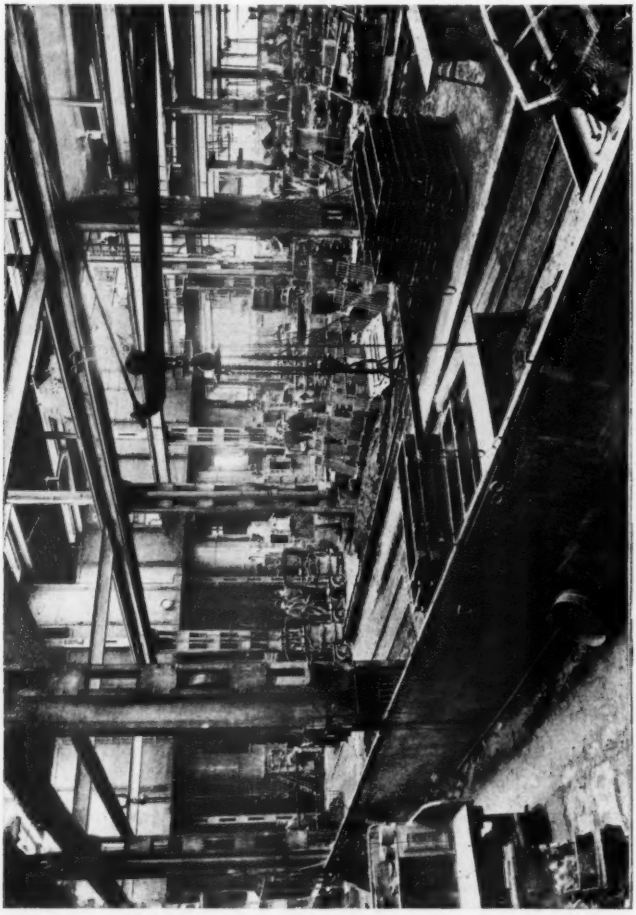


FIG. 16—SHOWING CUPBOARD OR CLOSET ALLOTTED TO EACH MOLDER, ALSO FOUR OF THE SIX CUPOLAS.

disk, which fits inside the bushing, is the same as the length of core desired, the sand rammed in and by another half turn of the hand wheel the plate drops back again, leaving the core standing free. The machine is specially useful, where many cores of the same size have to be made, but as it is now designed, the cores are perfectly straight and if any taper is desired by the moulder for the part fitting in the cope print, it must be put on with a file, before setting it. A dumbwaiter carries the cores from the gallery down to the floor.

Fig. 16 shows the bay used for making the larger radiators. Two molding machines, one partly shown in the right hand corner of the picture, are located here. The one shown is a hydraulic machine, the other is operated by hand. To each one belong four men. The pattern plate on the hydraulic machine is kept warm by a steampipe cast in it, on the hand machine by a gas pipe, so as to make it lift out of the sand better. Over the two machines is placed a jib crane with a small chain hoist. For setting the flasks out on the floor, the two overhead run ways with trolley and chain hoist shown in Fig. 16 are used. For pouring the flasks are laid on inclined beds, so that the heavy end or foot of the radiator, where most of the gases are developed, is placed higher. These beds, which are seen under the suspended flask, are built of brick, covered with sand and with an iron rail at upper and lower side. A straight edge also seen under the flask with a notch at one end fitting in one of the rails, is used for sweeping the sand between the rails. Four projections on the straight edge sweep as many grooves in the sand to let the gases escape from under the flasks. The iron grates seen standing along the side, are used for bolting the copes down to the drags. Each radiator is tested under a water pressure of 9 atmospheres, or 135 lbs. per square inch. In the next bay is a handy arrangement for casting straight and taper rolls for cotton milling and similar machinery, up to about 9 ft. in length on end It is shown in Fig. 16 A, and consists of a pit with brick walls all round. To the front and rear walls are fastened the flasks with bolts that are anchored through the walls. The front part of the flasks is fastened to the rear with wedges so that it can be

loosened and slid a short distance back on pins. In this manner the sand can be knocked out conveniently after the mold is poured off. Both parts of course are well perforated so that the gases can escape, and to the bottom is hinged a cover with a turned taper recess in it, to set the core by. On top the latter is exactly of the same size as the mold, which is closed up in this

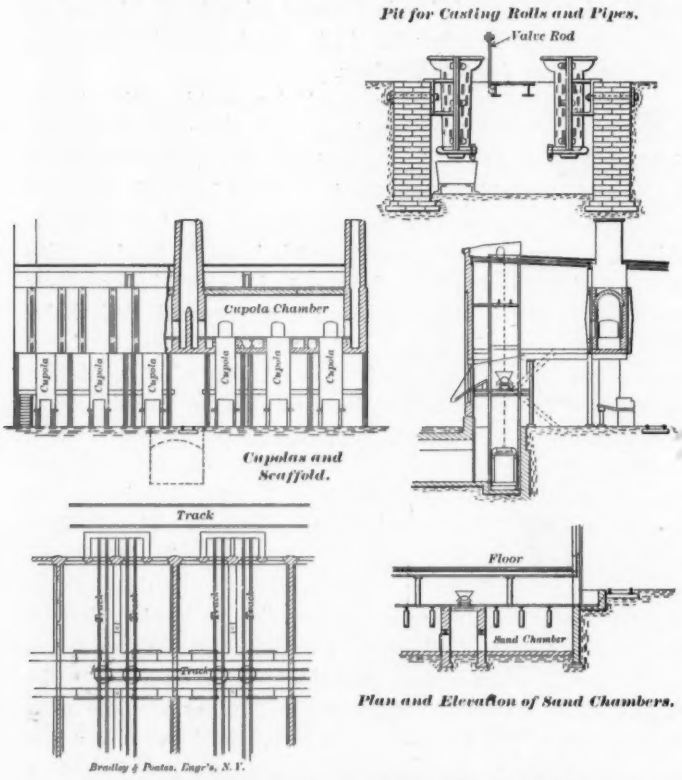


FIG. 16 A—PIT FOR CASTING ROLLS—ARRANGEMENT OF CUPOLAS AND SCAFFOLD—PLAN AND ELEVATION OF SAND CHAMBERS.

manner. There is room enough in the pit under the flasks to set a small coal furnace for drying the mold. Between the two rows of flasks is a light platform resting on I beams, along the

side of which runs a rod actuating the valve of the hydraulic travelling crane, which is placed on the track over head. This crane is used for drawing the patterns, setting the cores and handling the castings. Beside the hydraulic crane there are in this and the next four bays two hand cranes and six electric travelling cranes of the three motor system with from 4 to 5 tons capacity. Under these cranes the somewhat heavier castings for cotton milling machines and steam engine details suited for this size of cranes are cast.

Fig. 17 shows some pulley molding machines, the principle of which can readily be seen from the picture. The flat table consists of a large number of concentric rings, each one of which can be raised up as high as 8 ins. from the table by turning the large hand wheel, thus forming one-half of the rim. With the small hand wheel seen to the right, the pointer between the two wheels can be raised or lowered in the vertical slot. This pointer must be set to the desired diameter shown on the scale next to it before turning the large wheel. The intended width of the rim is measured off when setting it. The diameters vary from 9-16 in. on the smaller to $\frac{3}{4}$ in. on the larger pulleys up to 39 ins., which is the largest size the machine can make. Two corresponding sets of arm patterns are kept on hand for heavier and lighter pulleys.

In Fig. 16 are plainly visible four of the six cupolas which again present some peculiar patterns. They are somewhat smaller than those of the other foundry. The receivers, the largest of which holds $2\frac{1}{2}$ tons are all square. The bottom is built of fire brick and fire clay, and the whole front is arranged as an upper and lower door, swinging on hinges. The lower door, to which is attached the tap trough, is first shut, when preparing to take off a heat, and the joints closed with fire clay through the upper smaller door. The latter overlaps the lower one and when closing it fire clay is put along the edge of it, which afterwards is rubbed all round into the joints by the cupola tender, who can reach down to the inside through a slot on top of the receiver. The inside of the doors are lined with fire brick,

between two of which in the lower door is left a small opening for the tap hole. The stacks of all six cupolas only reach to about three feet above the platform, where they terminate in one common chamber 76 ft. 9 ins. long and 5 ft. 3 ins. wide, built entirely

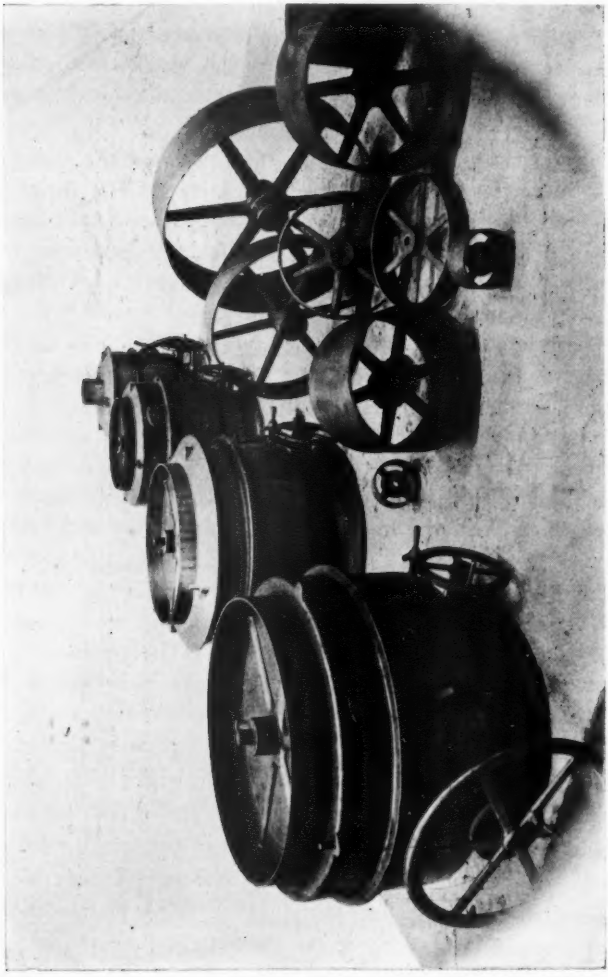


FIG. 17—MACHINES FOR MOLDING PULLEYS.

of brick. This chamber was made for the purpose of depositing all the sparks and cinders, instead of letting them escape to the roof. As seen in Fig. 16 A there are three chimneys leading from the chamber through the roof, one in the center and one at each end. These are connected with the inside of the chamber by means of openings 4 ft. 7 ins. wide and 3 ft. 11 ins. high. For each cupola an arched opening is cut through the wall of the chamber towards the scaffold, 2 ft. 11 ins. wide and 4 ft. 3 ins. high. These openings, however, are not provided with any kind of a door, but are left open all the time. The scaffold, which is 17 ft. 4 ins. above the floor, extends over a space 77 ft. long and 27 ft. 9 ins. wide. Above it, at the rear, is built another narrow platform, extending over the whole length of the lower one, and carrying a track running to the elevator. All of the pig, scrap and coke, except the runners and risers, are brought to the building from the yard of the large foundry in cars by means of an underground passage under a public thoroughfare, separating the two buildings. The 1½-ton hydraulic elevator comes down to this passage and raises the coke cars to the upper platform, and the iron cars to the scaffold. The coke cars are run along the track, and the coke dumped into several bins built on the scaffold for storing fuel and iron. In order to conveniently carry off the slag, and burnt coke, they are loaded on a small dumping car. The latter is run in the elevator to a special platform under the scaffold. There it is brought to a point near the wall, where the slags are dumped into a chute. In the wall is hinged the other half of the chute, which can be thrown out and a wagon run under it outside the building. As the cupola chamber prevents any direct communication between the scaffold and the cupola front, a speaking tube leads from one to the other, so that orders can be given from down below. An electric signal also leads from the cupolas to the power house for starting and stopping the machinery.

The cleaning room comprises two and one-half bays of the building. The first two bays are provided with the underground dust extractor described previously for the cleaning room of the large foundry. One of the holes leading down to it and covered

with a gridiron is seen in Fig. 18. A long cleaning table is covered on each side with a grate, over which the men clean castings, and through which a connection is also made to the underground channel. The machine with the circular table

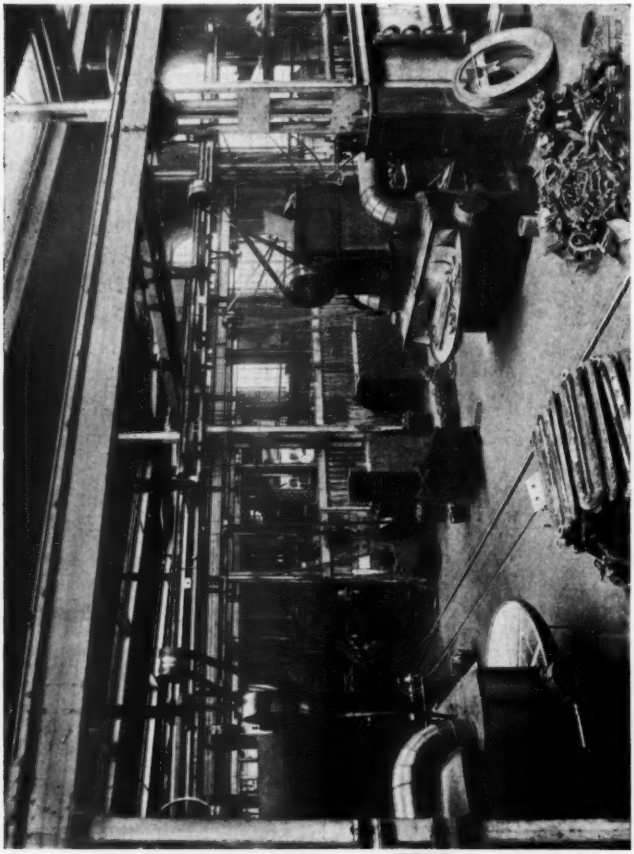


FIG. 18—SAND BLAST MACHINES FOR CLEANING CASTINGS.

shown in the foreground of Fig. 18 is a sand blast arrangement which has proved very efficient and economical in cleaning small castings. There are two of these machines in operation

continuously, both seen on the picture. The gridiron table on which a large number of castings can be put close together, is revolving all the time and is driven by a horizontal shaft seen on the side of the machine. Above the table in the part behind the rubber blinds, is arranged one long, narrow slot extending radially over one-half of the table. Through this opening the sand and air blast together strike the castings. The square box on top of the machine contains the sand conveyor (buckets on chain) which continuously fills a funnel on top. The large tubes, one on each side of the machine, are suction pipes, which take all the dust into the underground channel. The blast pipe enters the machine at the rear and, is therefore not seen on the picture. The blast pressure ought to be about 11 or 12 oz.; at present they use but 9 oz. Directly under the table is attached a wire netting, catching any small castings that may fall between the bars of the table. The sand itself falls through the netting on an inclined plane that brings it back again to the conveyor. One or generally two passages under the sand blast are enough to clean the castings on one side, whereupon they are turned over and go through the machine again. Further back are some Brown & Sharpe tumbling mills, covered over with a wooden box; the inside of the latter is lined with felt, so as to deaden the noise as much as possible. To the left of the track in line with the tumbling mills, are a number of small emery wheels, each one of which has got a pipe leading from under the wheel down to the floor and into the common dust extractor channel, to carry off the dust from the wheel. It must be specially remarked that owing to this system there is practically no dust to be seen in the whole cleaning room, and the air is as clean as can be desired for any machine shop. The line shaft operating all the machinery, as well as the dust extracting fan, are run by electric motors. Fig. 19 shows a cylinder for an inside connected locomotive that was just standing in the cleaning room at the time the pictures were taken. Both cylinders, 20 inches bore, the valve faces and the saddle for the boiler were cast in one piece, and the whole presented a remarkably fine appearance, the parts being very clean. Over this bay runs an electric traveling crane

of four tons capacity, to load the castings on the cars that are brought inside the building on a track.

The next thing of interest are the sand chambers in the annex above mentioned, for storing the crude sand (Fig. 16 A). There are thirteen of these chambers, some of which are built a

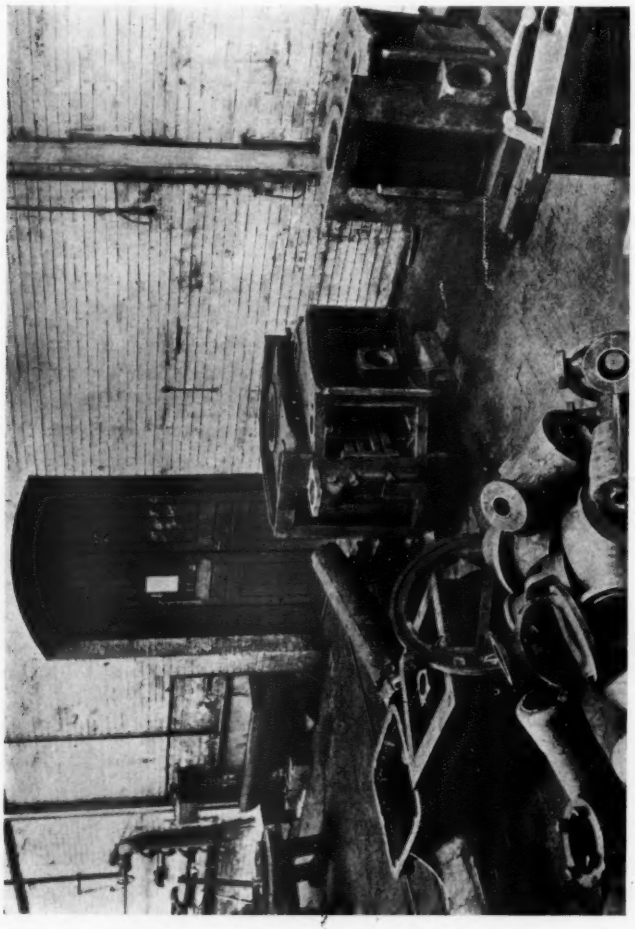


FIG. 19—CYLINDER FOR LOCOMOTIVE.

little larger than others, owing to the location of the building. The largest one contains 100 tons. They are partitioned off from each other by concrete walls, on which are also set the columns for the floor above. About 5 feet below the ground and 13 feet above the floor level of the chambers are located tracks for the dumping cars. These tracks run over the chambers as shown and through small doors in the front wall of the building into cuts close to the railroad track passing in front. There the dumping cars are loaded directly from the cars and run back into the building to the turn tables shown, which permit of bringing the car over the central passage to any desired chamber to the right or to the left.

There are two ways of getting the sand from these chambers to the first floor or to the sand mixing room on the second floor. The first is by means of an elevator, on which the sand is piled upon the carriage platform. On the first floor it may be taken off into a kind of a covered court and put on a drying floor 27 feet long and 10 feet wide. This drying floor consists of a number of cast iron plates, under which circulates the heat in two flues from a coke fire, located in a furnace at one end of that space. The sand is spread out in layers of from 3 inches to 4 inches, and it is possible in this way to dry 150 cubic feet per day. The same elevator runs up to the second floor, the sand mixing room, where the sand can also be dried on top of the large core oven located next to this room. The second way of taking the sand right up from the chambers to the mixing room, is by means of a conveyor chain with buckets attached to it. In this case the sand down in the basement is dumped on a revolving roll, that throws it on the buckets. On the second floor is located the usual chute through which the sand is thrown on the floor. From the first to the second floor there is a similar conveyor, to bring up the burnt sand after it has passed through a sand sifter. The top of this conveyor can be seen in Fig. 20, behind the nearest column. A little to the right is seen part of the drum of a mill in which they grind the charcoal for making their own facings. The machine further to the right is a loam mixer. More to the left are seen three "Fleury" sand mixers, the middle one uncovered. The

large wheel, the face of which is seen in the picture, is intended to crush the sand, the other is a bucket wheel that takes it up and throws it on an inclined sieve, placed round the central shaft. Through the sieve it falls underneath the machine, which

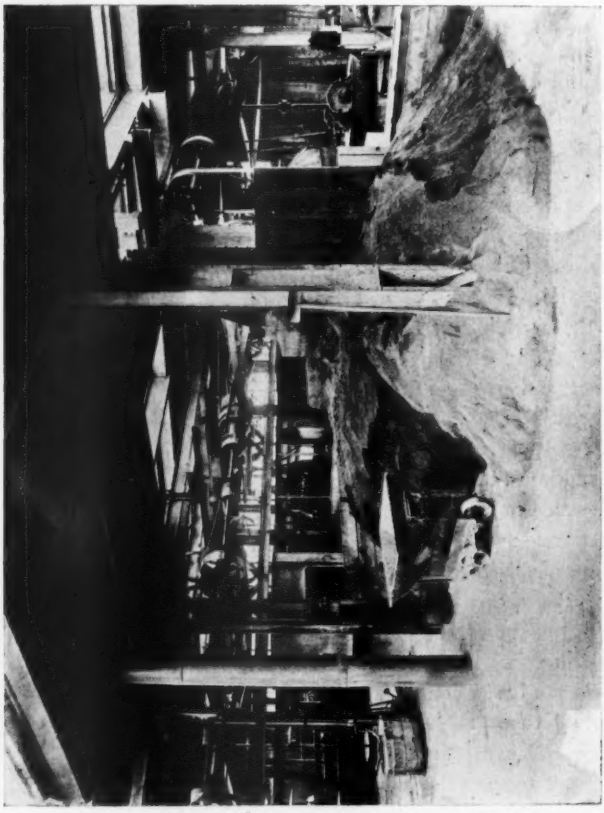


FIG. 20—CONVEYER FOR SAND—FLEURY SAND MIXERS.

stands on a circular concrete base. In these machines the old and new sand is mixed according to requirements. After that it is wet with a hose to which a spray nozzle is attached, and finally it passes through a centrifugal mixer, the top of one of which is seen at the extreme left of the picture behind the water barrel.

There are altogether three of these machines in line. The sand is thrown in the funnel-shaped cone located round the vertical shaft, and but little above the floor, which makes it very convenient for the men operating it. From the funnel the sand falls on a rapidly revolving disk, that has three or four rows of teeth (steel rods) projecting vertically about 1½ inches, through which the sand in thrown by the action of the centrifugal force. Below each machine are arranged two chambers and a hinged trap door can be thrown in such a position that the sand goes either to the right or to the left, in one or the other of the two. In this way six different kinds of sand can be mixed and stored away. On the ground floor each chamber has a door at a convenient height to let the sand out on wheelbarrows or on cars for distribution around the foundry. These three centrifugal sand mixers make at present about 1,500 cubic feet of sand per day, though the capacity of the machine is very much more. All the machinery in this department is driven with an electric motor.

The heating in both foundry buildings is done on a plan similar to the Sturtevant system, i. e., fresh air is drawn by a fan through a space filled with steam coils and discharged into the building. With the help of a shutter in the suction channel it is possible on very cold winter mornings to draw the air from the foundry itself over the coils, instead of the excessively cold air from the outside. This is quite feasible in view of the fact that early in the morning the air inside the building is comparatively pure. In summer the fan is kept going to take in fresh air and keep the place cool.

Before closing, a few more remarks of a general character ought to be made about various matters connected with this establishment. Test bars of every heat are not made, as is usual in some of the foundries in the States. They generally only make them when trying a new mixture. In such a case they use bars 1⅛ inches square for making a transverse test. It is claimed that too small a bar, as for instance, a ½ inch square bar, shows results that do not exactly tally with the actual conditions. The writer further saw a machine for making drop tests, for which bars 1 9-16 inches square are used, to find out how the iron behaves under

a heavy blow. This, of course, only gives comparative results, and no actual figure can be derived from it. Two angle or channel irons form a guide for a weight which can be raised to a height of 5 feet 9 inches or any distance below that. It weighs 26½ lbs., and is released from the rope by an arrangement similar to the usual drop. The test bars are laid on two knife edges 6¼ inches apart. A scale painted on the outside of the frame shows the height to which the weight is raised. The base is a solid cast iron block that weighs something over 1,700 lbs.

The concern has its own reservoir on top of a nearby hill, where water is pumped from a well in the shop, about 70 feet deep. The water pressure, due to the high location of the reservoir, is between 90 and 105 lbs. per square inch. For the city water, which is used for drinking purposes only, a tax of one cent for every 12 cubic feet has to be paid. It should further be mentioned that the concern has built near the shops a house containing large reading and dining rooms, fifty shower baths, two bathtubs and an office for a doctor where any employe can get medical advice free of charge any day during certain hours.

The principal work that the concern turns out of its own machine shop are steam engines, ice machinery, lake boats, steam boilers and heating plants. Considering the unfavorable position of Switzerland, hundreds of miles distant from the nearest coal and iron mines, and still further from the nearest seaport, and surrounded by large powers that all follow to a certain extent a protective policy, this shop certainly stands as a shining example of what can be accomplished with push, energy and hard work.

At the conclusion of reading the paper the convention adjourned until 10 a. m., Tuesday.

TUESDAY MORNING.

The convention assembled at 10:30, the first business being the announcement by the President of the committees appointed in accordance with the resolutions passed at the session on Monday. Following are the committees:

Committee to Revise Constitution—Geo. H. Carver, Chicago; Wm. H. Carpenter, Providence; Wm. Yagle, Pittsburg.

Committee on Nominations—J. R. Russel, Detroit; Wm. E. Sessions, Bristol; Geo. McG. Morris, Cincinnati.

The chairman then called for the report of the Committee on Uniform Apprenticeship System.

Mr. Bell, the chairman of the committee, then read the committee's report, as follows:

REPORT OF COMMITTEE ON APPRENTICESHIP.

Your committee on apprenticeship beg leave to report as follows:

It seems to be an acknowledged fact that a recognized apprenticeship system is not only desirable, but necessary, to keep up the standard of efficiency being called for in the foundry business, and in order to cover the entire ground and take care of the various branches of the trade, and to have the least possible complication, we have divided it into four different classes, with suitable terms as to time and compensation in each case, as follows:

1. The general machinery molder, embracing various classes of work from marine and stationary engines to all kinds of general machinery.

2. The stove-plate and agricultural implement molder. The reason for putting these two into one class is not so much on account of the similarity of the work, but because the systems and methods in both cases being usually based on piece-work, it was thought best to devise an indenture that would be suitable to these two branches.

3. Bench and brass molders. Possibly it would not be necessary to take them out of class No. 2, only that in these branches there is not so much skill required as in the first and second classes; hence it does not require so long a term of years for the learner, and in our judgment calls for the division as made.

4. As to special inducements for young men having graduated from manual training schools to take up the trade of iron molding and founding, we believe the desired end can be best accomplished by making a sep-

arate indenture for this class, believing such graduates will make the most desirable mechanics, and that their preparatory training will have given them such knowledge of the business that it will not take them as long to learn as the boy with a common school education. We would, therefore, advise a shorter term for these young men in each class, with a modification of the duties. We would also advise a more liberal compensation as an extra inducement. We do this on account of the fact that young men who have passed through manual training schools are better developed and of course have greater earning capacities than those entering the trade who are for years their juniors. This fact coupled with their better training and higher education, make them entitled to higher compensation.

While not wishing to discourage manual training school graduates who wish to take up work in class No. 3, we cannot imagine a case where a young man with such schooling would select this branch; but to provide for such we believe the present indenture entirely suitable and can suggest no changes. We would, however, strongly recommend that the requirements as to fitness of apprentice recommended in regular indenture shall also apply to these special apprentices, and that the following restrictions should be observed:

Section 1. No employer shall employ any indentured boy who leaves a previous employer for any cause, unless consent is obtained from his late employer, provided the employer has faithfully performed his part.

Sec. 2. After a trial of eight weeks, if satisfaction exists between both parties papers of indenture shall be made out.

Sec. 3. Compensation for services to be determined according to custom and conditions existing in the different localities.

Sec. 4. On condition of fulfilling all requirements in these indentures we would advise the following bonuses: $100.00 in Class No. 1, $75.00 for Class No. 2, $50.00 in Class No. 3.

In Class No. 1, known as machinery molders, owing to the diversified kind of work, ranging from the lightest to the heaviest, we believe a four-years' term short enough for any young man to be able to learn enough of the business to make him a proper mechanic, and where loam work is to be accomplished, we would advise one additional year on this special line.

No apprentice shall be indentured under 16 years of age or over 18 years, and the requirements or qualifications should be, first, a sound and strong body, well developed, a good common school education, coupled with a desire to learn this especial trade. The duties for each separate year and compensation for same will be fully set forth in the form of indenture submitted to you with this report.

Class No. 2.—Agricultural and stove molders.—As the work embraced in this class is not of such a diversified nature, nor has a great amount of core-work attached to it, your committee would advise a three-

year term as being long enough for a learner to master the trade, so as to be able to do justice to himself and employer. Where piece-work is the system, we believe it desirable to have the apprentice schooled in the same way, as it occurs to us that it would be much better for the boy, inasmuch as he would have his bad work discounted as is usual with journeymen, thus giving him the stimulus to have as little loss as possible, and for the stronger reason that it would be preparing him in the same way as he will have to work when he becomes a full-fledged mechanic.

No apprentice shall be indentured under 17 years of age or over 19 years of age, for the reason that he will be put to more laborious work sooner than in the other (No. 1) branch of the molder's trade, and the term of indenture will end at an age not too young to assume the duties of a man. Qualifications of applicants should be the same as in Class No. 1. The duties for each separate year, and compensation for same, are set forth in a copy of indenture accompanying this report.

Class No. 3.—Bench and brass molders.—While there is much skill required in the production of good work in some parts of both lines in this class, as a rule there is not so much as in the other two classes, for the reason that the larger part of this work is made from matchboards or cards, and patterns and rigging are prepared in such excellent shape that the actual molding is a comparatively simple matter. We believe a two-years' term in this class is sufficient, and the youngest desirable age at which to start an apprentice to be 18 years, for the reason that he must be strong enough to handle most of his molds alone, and any preliminary work he would have to do could not be of a much lighter character. Qualifications required from all applicants should be the same as in the previous classes. Duties for each year and compensation for same will be defined in a separate indenture attached.

INDENTURE FOR MACHINERY MOLDERS' APPRENTICE.

This agreement, entered into this .....day of .....A. D. 189...., between ..... a firm or corporation organized under the laws of the State of....., party of the first part, and ....., a minor, and....., parent or guardian, parties of the second part, Witnesseth, That the said party of the first part agrees to take....., party of the second part, into its employ and service for the period of four (4) years from date for the purpose of learning the trade of Iron Molder, as carried on in its works, and that the said minor party of the second part shall truly and faithfully work and serve for said period in such capacities as the foreman may from time to time direct, and that he shall obey all rules and regulations of the works, and the party of the second part also agrees to abstain from the use of intoxicatingt liquors during the term of apprenticeship. The duties of the apprentice are defined as follows, but may be deviated from so long as it does not impair the apprentice's opportunity to learn the trade thoroughly.

Nine months of the first year shall be devoted to making cores and taking care of core boxes, patterns, etc., and three months in taking care of cupola and ladle. Second year at light molding of various kinds and assisting in the care of patterns and helping molders, as occasion may require. Third year to be advanced to heavier and more difficult class of work as fast as he may prove himself capable. Fourth year, the first nine months to be spent on the best class of work in the shop, whether made in dry or green sand.

INDENTURE FOR AGRICULTURAL AND STOVE MOLDERS' APPRENTICE.

This agreement, entered into this .....day of ..... A. D. 189..., between ....., a firm or corporation organized under the laws of the State of....., party of the first part, and....., a minor, and....., parent or guardian, parties of the second part, Witnesseth, That the said party of the first part hereby agrees to take....., party of the second part, into its employ and service for the period of three years from date for the purpose of learning the trade of Iron Molder as carried on in its works, and that the said minor, party of the second part shall truly and faithfully work and serve for said period in such capacities as the foreman may from time to time direct, and he shall obey all rules and regulations of the works, and the party of the second part also agrees to abstain from the use of intoxicating liquors during the term of apprenticeship.

The duties of apprentice are defined as follows, but may be deviated from so long as it does not impair the apprentice's opportunity to learn the trade thoroughly: First six (6) months day work, to be spent in taking care of patterns and core boxes. Second six (6) months in the care of cupolas, ladles and flasks, so as to become conversant with their use before starting to mold. Second year to start at the more simple class of work, and the more difficult pieces of work to be given him as fast as he proves himself competent. Third year to be spent on the most difficult class of work in the shop.

INDENTURE FOR BENCH AND BRASS MOLDERS' APPRENTICE.

This agreement, entered into this .....day of..... A. D. 189..., between ....., a firm or corporation organized under the laws of the State of....., party of the first part, and....., a minor, and....., parent or guardian, parties of the second part, Witnesseth, That the said party of the first part hereby agrees to take....., party of the second part, into its employ and service for the period of three years from date, for the purpose of learning the trade of Iron or Brass Molder as carried on in its works, and that the said minor party of the second part shall truly and faithfully serve and work for said period in such capacities as

the foreman may from time to time direct, and that he shall obey all rules and regulations of the works, and the party of the second part also agrees to abstain from the use of intoxicating liquors during the term of apprenticeship.

The duties of apprentice are defined as follows, but may be deviated from so long as it does not impair the apprentice's opportunity to learn the trade thoroughly: The first six months to be spent around cupola, ladles and general labor, so as to become familiar with his surroundings. Balance of apprenticeship to be devoted to molding entirely, and to be given charge of work and a better class of it, as fast as he becomes proficient.

INDENTURE FOR MANUAL TRAINING SCHOOL GRADUATES.

This agreement, entered into this.....day of..... A. D. 189..., between....., a firm or corporation organized under the laws of the State of....., party of the first part, and....., a manual training school graduate, party of the second part, Witnesseth, That the said party of the first part agrees to take said....., party of the second part, into its employ and service for the period of three (3) years from the date hereof for the purpose of learning the trade of Iron Molder as carried on in its works; and, that the said party of the second part shall truly and faithfully work and serve for said period in such capacities as the foreman may from time to time direct; and that he shall obey all rules and regulations of the works; and the party of the second part also agrees to abstain from the use of intoxicating liquors during the term of apprenticeship.

The duties of the apprentice are defined as follows, but may be deviated from so long as it does not impair the apprentice's opportunity to learn the trade thoroughly: First three months of first year to be spent at taking care and charging of cupola, also lining ladles; next six months in core room; the last three months to be spent at bench molding.

The second year is to be devoted entirely to molding, the apprentice to be advanced from the small and plainer work to the more difficult and larger, as fast as his capabilities will prove it is profitable to do so.

The third year is to be devoted to the most responsible work in the shop, either in dry or green sand, as the capabilities of the apprentice may justify; and should he desire to learn loam molding, it will be necessary for him to devote one further year to this special branch of the trade.

Respectfully submitted.

C. S. BELL,
R. VIALL,
WILLIAM FERGUSON,
Committee.

The chairman complimented the committee on the thorough way in which they had done their work and said he had never

heard of an apprenticeship indenture which so thoroughly hit the nail on the head. He suggested that the paper be printed and circulated among foundrymen in general, and thought all would agree that the committee were thoroughly well posted on the subject.

Mr. Bell: If it would not be imposing too much on the Association I should like to make a few remarks on the report. The committee cannot take all the credit for this report, and we are especially indebted to the Western Foundrymen's Association for much of the material composing it. There has been in other schemes or plans an effort to reclaim a certain portion of the wages of the apprentice, the amount thus reclaimed to be paid to him at the end of each year for good behavior. We eliminate this idea for the reason that you cannot always know that they deserve it, and it creates a great deal of hard feeling and a much dissatisfaction would result, to the injury of both employer and apprentice. We therefore eliminated the idea of giving a bonus on discretion, but we have suggested a plan of giving compensation upon the performance of the whole contract at the end of the term of service. Those who have served four years would be entitled to $100. It will not have been detained from them or kept out of their wages, but given as a reward at the end of their service. I doubted myself, and the other members of the committee agreed with me finally, that, if we undertook to hold back from their wages weekly, monthly, or yearly sums to be repaid at the end of a year or end of a term, the position could not be maintained. They could go into court and collect it in many of the States, and I am of the opinion all of the States, as it would depend on the decision of a jury whether you were liable or not. I very much believe that the jury would decide in their favor. This step would create an ill feeling and have no beneficial effect. In the plan we approve there is an inducement to the boy to behave himself to the end of the term so that he would get his reward. That is one of the points on which this report varies from others submitted. We have put in a section deciding that no foundryman shall employ any indentured boy discharged for

any cause unless consent is obtained from his late employer. An objection is raised to this section on the ground that it is a boycott. The former employer has a contract with that boy which he has a right to maintain. If the boy goes anywhere else for employment the legitimate employer has a right to ask that he be not employed as he belongs to the former employer. I do not think that the idea is a boycott in any sense of the word, as the contract is plain as existing. We thought best also to make the probation eight weeks before the indentures are signed. In eight weeks you can learn largely the disposition of the boy, whether he is going to be suited to the business or not, and then it will be time enough to make the indentures. The question of compensation came up. It has been in other reports a fixed sum. My contention against the adoption of a fixed sum was that there were so many conditions existing that would be applicable in Chicago that would not be in Detroit, or a country shop, and it would also be different in a New England shop. One of our committee was from one of the finest New England shops and he thought it would not be advisable to fix the terms of compensation as they would not be applicable to his section. We have therefore left that part to the conditions existing in each of the localities where the works are situated. That is a matter that can be regulated just like any other compensation for services. These few remarks I believe cover the ground we had in dispute, but they may not be in dispute with you and you may agree as you think best.

I would like to say that Mr. Viall, of the Brown & Sharpe Mfg. Co., Providence, R. I., is present and has prepared an article on the subject that has been published in the trade papers, but is new to most of you. It would be well for him to read it to you.

Mr. Viall: Unfortunately, I have lent the paper to the "American Machinist." Any of you who take that paper will remember some three months ago or perhaps four that the question of the apprenticeship system, not only in foundries but in machine shops and in other mechanical trades shops, was brought up, and quite a number of articles appeared on the subject. The Brown &

Sharpe Co. were applied to for their opinions in regard to it. I myself have always had decided opinions in regard to the apprenticeship system. I was an apprentice myself. The substance of the article perhaps I can tell you. In the first place I believe in apprentices, and I believe that the shiftless workmen we have in all trades, not so much perhaps in the machinists' trade until late years, but largely in the foundry trade, is largely due to defective apprenticeship system which tends to make unprofitable and shiftless workmen. I remember one time a man coming to Brown & Sharpe's and asking Mr. Sharpe whether he could advise him where he could find a young man to take a superintendency or foremanship in his shop. After talking some time Mr. Sharpe asked the man why he did not select a man from his apprentices, and he replied that he did not take any apprentices. Mr. Sharpe then said he would not talk further on the subject, as he had no desire to help a man who did not believe in apprentices. Those were his sentiments and are mine also. In the system we had previous to perhaps ten years ago apprentices were bound and their parents or some one would be responsible for them. We found on taking the matter into court that the apprentices got clear. Then we devised the plan of having them pay $100 and learning the trade in the shop. In many of the sections of the country it is hard to manage this, and it is hard with us. We do it in this way. If the parents or guardians are not able to pay that sum down then we take a certain amount from the wages week by week, or month by month. Then they may pay a certain amount down and the balance in six months or so. At the end of the term of apprenticeship the money is returned. That is the way we keep our boys. Most of our departments are managed by boys who learned their trades with us, and they are the best we have. Our boys are scattered around the country, though most of them have stayed with us several years before leaving, and some have never left us. We have over thirty departments and the man who takes charge never worked anywhere else than in our shops. It is so in many of our departments. We have sixty to seventy apprentices. Our plan is a little different from that contained in the report before us, but I believe we have arrived at something that

is worthy of consideration at least. It may be discussed and perhaps modified, but it is food for consideration. I want emphatically to impress upon your minds my sentiments in regard to the apprentice question, and I believe we can get better men under a better system.

Mr. Ferguson: The report of the committee has been presented to the convention, and we have heard further from the committee. I think it is in order for a motion that the Association adopt the report of the committee and so bring the matter before the meeting in a business way.

Mr. Yagle: I moved that the report be received for discussion.

Motion duly seconded, put and carried.

Mr. Morris: It seems to me the report states that in the event of an apprentice being discharged by his employer that apprentice should not be employed by any other person without the consent of the former employer. Is that correct? It would seem to me the proper thing if a boy left his former employer, but if a boy is discharged it should not be necessary for him to have the consent of his former employer.

Mr. Bell: The gentleman is correct. The report was prepared very hastily. If an apprentice left his employer he should not be employed without the consent of the employer. Of course, if a boy is discharged he is under an obligation no longer. It might be better stated. It was meant to say that if a boy left his employer no other member of the Association would employ that boy unless with the consent of his former employer. It is possible he would be very willing to grant the consent. If a boy is in your employ and his associations are not of an acceptable character you would be very glad to have him out of your shop. But you would not want to put a stumbling block in the way of his getting employment elsewhere. As I understand it, if the proprietor of the works discharges a boy he discharges the obligations of the boy to him.

Mr. Rohland: I think the manner of starting is right, but the limitation of age, 18 years, is rather too short. We have a number

of boys going to school and perhaps their schooling does not end until they are 20 or 22. Those boys should have the privilege of learning a trade as well as not. I think the limit should go from 16 to 20 at least. I think a great many young boys should learn this trade.

Mr. Ferguson: I believe that class has been taken care of in the report of the committee, under the head of manual training schools or technical colleges, in which no age is stated. I think that covers the case.

Mr. Rohland: There are no manual training schools in some districts, at least not in Drifton, where we have a number of apprentices, and take them up to 22. I think some of these make the best and brightest men in the foundry as well as the machine shop.

Mr. Devlin: If this resolution is adopted at this meeting what effect will it have on the foundrymen of the country? Is it intended to be binding or only a suggestion?

The Chairman: It would be in the form of a suggestion; a plan promulgated by the Association for a basis of a system for taking apprentices.

Mr. Devlin: I was going to suggest before anything was done definitely that each class as a whole class be consulted, as I believe it could be only a whole class that could prepare an intelligent system. For instance, bench molders, whom I know more about than stove or machinery molders, are classed as a very low class of mechanics. That may be true in some places where they have only a few things to make, but where there is a great variety of work it is not so simple a branch as some seem to think. In regard to another point raised I may say we had a system of retaining fifty cents a week on each boy, but found that so very unpleasant that we abandoned it. If a boy wants to leave we are glad to get rid of him as he is generally not a good boy. We have found that the boy who wants to stay is the only boy worth having. In other words it is the survival of the fittest that works the best in foundry practice. If this scheme is only a suggestion I

should not object to it, but if it is to be binding I should vote against it.

Mr. Lanigan: I might say one thing in relation to a foundry apprentice and it is this, that in a machine shop the machine does the work and furnishes the brain, while in the foundry the man furnishes the brain and does the work. I cannot see for the life of me why an apprentice in the foundry should be put in the same category as the man in the machine shop.

Mr. Best: Mr. Lanigan is right. If a machinist's boy goes in to the shop to learn to be a machinist and the machine does the work instead of the brain, who makes the machine and whence comes the brain to furnish the machine? I consider there are as good mechanics in the machine shop as in the foundry. Some I expect are worse than others. It is only the boy who uses his brain and strives to serve his employer and do what is right and proper that will succeed. As Mr. Devlin says, it is the survival of the fittest. In Warden, King & Sons' foundry in Montreal we have a number of apprentices; some are bound by letters and we retain a fee taken out of their wages until the sum amounts to $50.00. Some boys after a time are glad to get away and we are glad to get rid of them, in fact we would give more than we return to them to get rid of them. Others remain their time and are received into the shop and turn out to be good men. We have a number that have been in our employ twenty-five years and they are getting as good wages as anybody in Canada. But to be successful they must exercise some practical thought and knowledge, and not trust to those who have gone before, or do as their grandfathers did, or they will be left.

I. N. Frank: In reference to the time of probation, I have had something to do with the employment of apprentices for twenty years, both in the machine shop and foundry, and I say with a good deal of regret that while the machine shop apprentices have turned out well within that time and a number are being employed by our firm to-day that were apprentices sixteen years ago, I cannot say that much for the foundry. Very few good apprentices have been turned out in the foundry. There is some reason

for this. Something is wrong, some system is wanting. The same establishment turning out good apprentices in one department and poorer ones in another would make it appear that there is a lack of knowledge as to how to proceed. There is a resolution before us for adoption by foundrymen of a plan which points out a way to get good results. In the machine shop we pursue the systematic policy of advancing a boy by steps. In the foundry the boy is perhaps put at the core bench or elsewhere and not looked after. It seems to me that the plan before us points out the way, and gives an apprentice the right to demand means of learning his trade. That is a thing many employers overlook. They take a boy into the shop and he shifts around and takes care of himself throughout his period of apprenticeship, and when he is through he does not amount to anything. I think eight weeks' probation is too short a time of probation. Many a boy will come on enthusiastically for a time, entering into his duties with vim, and taking great interest, but after a time he lags and becomes a most worthless boy. I think eight weeks is hardly time enough for the feeling of interest to wear off. It is our custom to allow six months, and we find that many drop out before the end of that period because the novelty has worn off the occupation. After eight weeks we might retain many boys that would drop out in six months. I think it is the earnest character of the boy we should look for and I would suggest that the period of probation be changed to six months. That opinion is based upon the experience I have had in taking boys into the machine shop, pattern shop and foundry. I would offer that as a suggestion.

Mr. Campbell: I have been the means of learning numbers of boys their trade in a technical foundry business, and I must say that eight weeks is a little short; three months is nearer, but six months is too long. Any foreman can tell in three weeks whether a boy is going to be a worker or not. In three months he puts him on the core bench or working with a molder on the floor. The main reason why apprentices do not stay in the foundry is that they have to work, and work hard. It is altogether different in the machine shop, the conditions are different; the boys do not

get themselves so dirty and their conditions are not so uncomfortable, for that reason we cannot get as good material to enter the foundry to learn the trade. In the New England states, where I am, it is very difficult to get good boys to learn the foundry business; they are shy at it, and I have had boys whose parents have told me that it is such a dirty trade. A boy must have plenty of brains to learn the trade and to be a good molder, more brains, it seems to me, than it requires to be a good machinist. As Mr. Lanigan says, "the machine does the work." I do not wish you to think that I detract from the fact that there is not good in all trades, but the conditions should be made somewhat easier in the foundry business than they are if we want to get the best apprentices.

The Chairman: A man with ordinary intelligence can be utilized in the foundry and a man with the highest intelligence—that goes without saying. I think the report of the committee is a frame work or skeleton that can be modified. The time of probation might be changed from eight weeks to three, six or eight months, and the age period from 14 years to 20, leaving that question with the founders themselves, but the frame work is of great importance. I would take that report, and if I thought it worth while to change the time of service, or the time of probation, or the amount of compensation at the end of the period, I would do so. If I chose to put my man in the next class above I would do so. I think the report valuable as a skeleton to base action upon. We have nothing of the kind in existence now.

Mr. J. G. Sadlier: I went through the apprentice system in the foundry myself and there is no question at all, it seems to me, in regard to the brains needed in the foundry or machine shop. It requires a deep thinker in both. I do not know any mechanic, in either machine shop or foundry who has gone to the top of the tree. There is a little brain work in each part that has not yet been reached, or that I have not yet come in contact with. In the foundry probably the apprentice has much less care and less attention shown him than anywhere else. In the first place we find a great many foremen of foundries that are too arbitrary

with their apprentices; they do not take an active interest in instructing them, or in instructing them they set down arbitrary rules to govern them. The best apprentice is made by encouraging the boy to do his own thinking, to make him reason it out himself, if possible; not to rebuke him or ridicule him simply because he has made an error, but to caution him against making that error again, and leave him, if necessary, to find the error himself, to see what was the cause of it. Make nothing but a trifle of his error; see if he understands why his work was lost, and in that way learn him to take an interest in his business and make him think. The boy who watches the clock to fill in time makes a poor mechanic in any line of business. I have had some experience, and when I see a boy watching the clock I make up my mind that that boy is not in his business and will not make a mechanic. That is the rule I have. It seems any boy who does that is of no use. I think the system suggested by our committee here is an excellent one, though it seems to me there is one point that might be mastered, and that is the amount an apprentice might be allowed in proportion to a journeyman, similar to the system adopted by stove manufacturers. That ground should be covered, as in many cases that is really the ruination of the apprentice system in this country for the fact that at times there will be a certain number of men in the shop to cover a cheaper grade of work to be got out and which can be got out by cheaper labor. It is hard then to take care of the apprentice. If that shop has no further need for the cheap labor then the laborers have to go somewhere else, and will perhaps drift into another shop and call themselves molders. There are numbers around the country in that way trying to get an education in the foundry business without serving an apprenticeship.

Mr. Bell: In order to correct this paragraph here, I beg leave to move that the word "discharge" be stricken out in Section 3, and that we insert "who leaves his employer." It would then read thus: "No employer shall employ an indentured boy who leaves his employer for any cause, unless consent is obtained from his late employer." I move that as an amendment. If there is no

objection we can consider that amendment as adopted, and offered by the committee.

Mr. Leland: It seems to me that it is hardly equitable, and after a lengthy experience I have learned that any contract is undesirable for both parties which is not entirely equitable to both. There are instances where the employer is an unscupulous man, and he does not teach the boy anything. According to this, we recognize that the boy who happens to get into the hands of such a man and leaves him because he has given him no opportunity to learn anything, and who will only know how to be a chump when he gets through, will be barred for all time in the foundry business. Such a boy would have to get the consent of that man before he could obtain new employment. I do not think this would be just.

Mr. Bell: As a matter of course it will be impossible to make perfect employers as it is to make a perfect apprentice. We cannot legislate against the brutality of men; we can only provide that proper men and who belong to this Association shall do these things. I do not think it would be possible for any employer to so discriminate against a boy as to discharge him at any time so as to get rid of the responsibility for completing his service. I do not think he would do it if his rights were considered, regardless of the brutality of his employer. I want to say another thing. Many of these suggestions will be impracticable unless we intend to turn over a new leaf. Remark has been made in regard to the imperfect teaching by the foreman; unless we are going to adopt a system of education for boys in the molding trade we can make no rules at present that are of any value, but if we are going to encourage a new era in this matter it should be the duty of the proprietor to have such a foreman as would teach as in schools and in colleges. You could not do that by a law in this Association. It is only by a determination of the trade that we will do different in the future and turn out not chumps but mechanics. This is an entering wedge starting in that direction. We do not expect to reach that to-morrow or next week, and turn out all this business in one whirl, but we

must begin somewhere. Here we have an outline, imperfect, I admit, but a sort of policy tending to change the method of educating molders. Boys who are not treated properly and are kept on one thing all the time naturally become disgusted and they go off to other shops and you have no word to say about it. Half taught men are filling foundries to-day. What we want is to make a move towards doing better and making a better class of mechanics.

Mr. Brayer: I think this is a very valuable paper. The committee is entitled to our hearty thanks for the labors extended on the report. It is hardly to be expected that all the foundrymen are going to adopt rigidly every provision of this report, but it is valuable as a suggestion. The subject is new to a great many of us, and I think if we keep on we could discuss that subject all day. I think it is going to be put into practice universally, and it could not be expected that anything so important could be changed all at once. I think it would be better to adopt this report as it is and continue the committee for another year. In the meantime we can adopt as much of it as we like. We should have it printed and sent to every member, and another year it would bring forth many valuable papers and suggestions. This same committee has done so well that I think it would be well to continue it. I would move that the report be adopted and printed. Before the discussion closes there is one recommendation of the report I do not approve, relating to time of service of bench molders. In the foundry with which I am connected we employ bench and floor molders, and I am quite certain that two years is too short a term in which to teach a young man to make small jobbing machinery castings, and I would not like to see this Association go on record as adopting the position that a young man can learn the bench molding trade in that line in two years. I would like to see it changed to three years.

Mr. Devlin: Our time is three years. We have always had three years and find no difficulty in making molders in that time, but our experience is that we could not make them in less than three years. I for one will vote for the resolution as it stands, al-

llowing only two years for bench molders where they have patterns or follow boards, and fixed up so that the molder has nothing to do. It might be time long enough, but to learn to make matches and cut gates, and put on shrinkers, and different kinds of work, two years is not enough, and I move that it be amended to three years.

Mr. Morris: I have another suggestion to offer in connection with this report of the committee. I suppose we have all had experience with molders who travel the country and represent themselves to be molders, having served one to three years, all sorts and styles, but we cannot tell except from their talk what they are. It would be a good inducement after a man has served his time to give him some compensation in the way of a diploma, that he might convince the foundryman that he is a journeyman and served his time in a reputable shop.

Chairman: The suggestion is, of course, good, but eventually all these rules will be modified and changed by the committee as we discover the necessity for changes. I cannot see how the committee could consider all the various points in the short time they had to prepare the paper, and we must not forget that it will always be suggestive. We, of course, desire to make it as uniform in adoption as possible.

Mr. Metcalf: In regard to Mr. Morris' remarks, I think that while the subject under discussion is on apprenticeship, our experience has been that the men mentioned have not served apprenticeships as molders; they go around the country and represent themselves as molders, but they have no papers to show that they are molders. In Sweden an employer is compelled to give a man, on leaving his employ, a paper stating that he has served a certain time in his employ, and if the man has been a good man he wants to give that man a recommendation. He can state it in that paper. It is not necessary, however, but if he states that a man has been in his employ ten years that man can take that paper to another shop and get employment, and they know he must have been efficient or he would not have been there

that length of time. We had an apprentice in our shop who thought he had been too long on the core bench and wanted to learn molding, and he left his work and came to me. He wanted me to put him back again, so the foreman put him on the floor to see if he was any good. He worked on the floor several months and he was altogether in our employ eighteen months. He was no good on the floor nor good at making cores, and he left us a second time. He is employed now in Pittsburg, in a neighboring shop, as an expert coremaker, and he gets coremakers' wages. He has been in several shops but is located permanently now. I think it is an injury to the trade that he should represent himself as a molder and coremaker. If I had been compelled to give him papers no one would have hired him as a molder or coremaker. I think some such provision should be made that a foundryman in discharging a man should give him papers, stating the length of time he has been in his employ. Nothing need be said as to whether he was efficient or not.

Chairman: The question is on the amendment of Mr. Devlin, changing the period of apprenticeship for bench molders from two years to three years.

Motion duly seconded, put and carried.

Mr. Metcalf: I have thought it would be well to add another word there. There are two parties to the contract, one party agrees to study, the other agrees to teach him. Make the contract for one as well as for the other. I would suggest that you put in the words "provided that the employer carries out his agreement." One word more will do it; nothing can be more important, than this question. We want men of ability, men of character and brains. And I hope we will not go away thinking there is no brains in the machine shop. There is a great deal of brain needed in the foundry and in many instances I am sorry to say it is conspicuous by its absence. The way to build this up is to have a thorough and uniform system adopted, especially as to time, so that we know the man has had a training. The training of the boy is important. Do not let him work out his own salvation, let the foreman teach him, let the Association

stand behind this movement and every member use his influence, and great good will result.

Mr. Lanigan: I hope the gentleman is not getting the idea into his head that I said we want no brains in the machine shop. In my opinion, though, it requires more brains to make a good molder than a good machinist. In relation to this apprentice question, I want to say something more. I am a molder who hadn't much opportunity to get an education in my early days. I have boys and they can ask me questions that knock the wind clean out of me. My boys do not want to be molders for the simple reason that people in general have established a degree of respectability for a machinist which they do not want to give to the molder. And now there is this form of apprenticeship, which gives the boys from a technical school a degree of respectability over the boy that has not had a technical education. If they put both in a foundry, and they are required to serve two years, the chances are a hundred to one that the boy with the smaller education will have more brain in the foundry, for the reason that he will apply his brain to the work, and the other fellow will apply his brain to something higher.

Mr. Viall: I would like to say one word here about what has been said here about giving apprentices certificates. Perhaps our method in that line may lead to something. Our apprentices' papers are made out regularly, and when the apprentice's time is complete they are brought to our office and the president signs them, showing that the apprentice has fulfilled his time of apprenticeship to our entire satisfaction. Those papers are held by the boys to be of great value, and I think they are. If any of you people hire a boy from Brown & Sharpe's works to work in a foundry or any business we have instructed him in and he presents one of these papers, he should be a first-class workman, and you will know that he has been through the shop. That is the way we turn them out, and the boys carry their papers with them.

Mr. Groves: It is the opinion, around here at any rate, and I have heard it expressed outside in regard to Brown & Sharpe, that a boy goes into your works with the intention of becoming

a mechanic. This firm does a specialty business, we know, and I would like to ask Mr. Viall whether they put a boy on a certain class of work and when he is proficient whether they bring out another boy and put him on that work and put the other boy on a new class of work? Do they pass them through every department or do they make them simply machines, familiar with one class of work? I do not say that they do, but it is an opinion common about the country in regard to specialty shops.

Mr. Viall: We have a great many experts throughout this country, one of them is superintendent of the Morse Twist Drill & Machine Co., the business of which firm is entirely unlike our own. Another is superintendent in the works of the Sprague Elevator Co., another business unlike our own. A gentleman who is here, learned his trade in our shops and I should like him to tell you what he went through. He is in an important foundry, and I say that he is not only capable of running that foundry, but I believe from my knowledge of him that he can go into any foundry and make his mark there and do good work. Now we intend that our boys shall go through a regular system and through all departments. They are carried from the floor to the core room, and work on the bench and on the floor. A boy also goes through all the different branches in the machine business in our works, and all the boys are taught to do things that other shops pay no attention to. We have a system that may be made better, but at any rate we have a system and we follow it up. Our boys will rival any other set of boys from any other foundry. They are filling important positions in this country. We take pains with them. I do not think a boy goes into our works without a desire on my part to help him. Every foreman instructs him. We have a man whose whole business it is to look after the apprentices. His first duty is to take the apprentice's name and place of residence and find out what he is, and he then follows him up and takes care of him. He shows him how to grind a tool, initiates him into the rudiments of the work of apprentices and all other things. This idea I have been trying to carry out for the last seven years, but have only lately succeeded, as the foremen objected to it. But it works to the benefit of all concerned.

I believe the discussion I have had with our friends from Chicago and our friends from Cincinnati here has paid me ten times over for coming out here and my employers also. You can get up here and name this thing and the other thing, but Mr. Ferguson has literature, numbers of letters and all sorts and kinds of suggestions from all parts of this country, and I have had the benefit of all that system and the experience of Mr. Bell also, and even then it is hard work to say just exactly what should be done. If we could get started in this matter and say we will go into the apprentice system and stick to it we will get a system that will be of benefit to the country.

The President: The motion before you is the adoption of the report of the committee.

Mr. Ferguson: As one of the committee I am much pleased at the liberal discussion we have had. It is evidence to me of the recognized fact that a system of apprenticeship is desirable in the foundry. I have worked on this thing for twelve years past, and have tried to adopt it in my own way and with more or less success. I may say with success under any system is better than no system at all. This report as presented here to the Association is a compilation of work and opinion and advice by the leading foundrymen of the country and is put in the best form possible. I do not agree with the gentleman here that suggested referring this matter back to the same committee for another year. If you refer it back one, two or three years I do not believe more could be accomplished. There may be changes made in it from time to time as they may be found necessary. I was not altogether pleased with the motion to change the term of service in the third class from two to three years. I believe any changes in that report should be made by the committee after reference of the matter to them.

The President: Well, the motion is to adopt the report of the committee.

Motion seconded, put and carried.

Mr. Brayer: In due time we shall receive this report and read it at our leisure and I move that this committee be retained and any of us during the year who have ideas on the subject should write to the committee, and if any changes are found desirable we can make them. I move that the committee be continued for another year.

Motion seconded, put and carried.

Mr. Flather: Many of us are interested in the technical and practical side of the work the Association takes up. Some of us came here on account of the programme sent to us, and the first two papers on the programme we expected would be given to us early in the proceedings have not yet been taken up. We have been very patient in listening to some of these matters, and I would like to have these two papers read before us as soon as possible. I wish we could have a meeting to-night and have Mr. Beckett's paper read so that we could get something out of the Association before we go away.

Mr. Penton: This matter has been carried forward as fast as possible. In order to conduct an Association like this routine business that accumulates during the year, reports on constitution, standing committees, etc., have precedence. These papers are only to fill in. There are reports from standing committees appointed many months ago and they must of necessity have precedence. As soon as there is a vacancy and anything drags the papers will be brought in. Two standing committees are now ready with their reports, one of them we have just heard. It is absolutely necessary that the report of the other committee be taken up immediately. Mr. Beckett's paper will then be read. The matter of meeting this evening can be arranged this afternoon when we are on the boat, and if it is the sense of this body that we hold a session this evening we will hold one. But it is really necessary that the business of the Association be presented as rapidly as possible and that the matter I have mentioned be taken up at once. I think that the report of the Committee on Defense should now be considered.

Mr. Devlin: I would like to know if any foundryman has asked for a report of the Defense Association. I have not heard that any one has asked to have a Defense Association established. I have been talking with a number of members and cannot find one who wants anything of the kind.

Mr. Penton: As Secretary, I may say that during the past year a great number of matters have been presented to the Executive Board for consideration. Among the many things we have heard from our people is the fact that we must have some practical good from the Association, something that has dollars and cents in it. It is not for the goodfellowship that we have come here, but for some real tangible benefit. This matter of having a Defense Association would perhaps accomplish a great amount of good for its members as it would give them the same benefit as is given to the members of the Stove Founders' Defense Association. The matter has been reported to the Executive Board and they have decided in favor of bringing it before the Association. Mr. Schumann appointed a committee three months ago, and they met, went over the matter carefully, during two or three days, and have prepared a report and that report is now ready. The chairman of the committee is here to present it.

The President: The question is, shall we receive the report?

On motion the report was accepted.

Mr. Pfahler: I am sorry that the presentation of this report is to be made at an hour so late in the day, and I am equally sorry that mention has been made of the matter in some of the local papers as well as the name which has been applied to the work. It seems to have created an impression different to that in the minds of the committee when the matter was referred to them. We have felt, after consideration of the subject bearing upon the relations of the employer to the employes, that it is one of the vital questions occupying the attention of the business men of this country. There is no doubt that in a business such as ours in which 20 to 50 or even a greater percentage of the value of our product is represented by labor there is no question of any interest

that is greater than the regulation of the labor question. Up to this time that question has been one of antagonism only and to-day I am safe in saying that the gentlemen here represented, who probably employ 10,000 people, stand in the minds of those people as their aggressors and opponents, and we are looked upon as employers of labor simply to grind that labor and to reduce it. Your committee believes there is a higher side. We believe that success in the future depends more than anything else upon a line of co-operation, and that that co-operation shall be with a body of men who are organized, who are organized to consider their interests, and who are often induced to consider by their leaders that their position must be met by a uniform movement of employers, not to oppress labor but to benefit it. Our experience has been, from letters we have had from a large number of employers, that there is no subject that can lend such interest to the manufacturer as that of co-operation with his laboring men. As individuals we cannot do much. As an individual employer your word to them has no value compared with the word of their organization. And while your men may take interest in your business, influence from an entirely different line of business may lead them to be finally antagonistic. There are sensible men working in our shops, probably more than we give credit for. One gentleman made the assertion to me the other day that he never had a strike occur in his shop which he believed was favored by 20 per cent of the men. I know of my own experience that is right. The men who stand with you claim your protection. You cannot say as an individual to those men, "I will protect you against your entire association; I will protect you against the vicious influence of your leaders."

We say we will protect the laboring interests in our employ, they will listen and understand that we are putting up a wall of strength to defend the best men we have, that is why I say the idea that has gone abroad that the movement is to defend us against somebody is wrong. I think it is a defense of our argument. In the stove business through all the depression our molders recognize to-day that our Defense Association has been their protection and they are stronger in favor of the movement that

they believe necessary than we are ourselves. I do not want to forestall the report except with these few words, explaining what I believe to be an erroneous idea. Your committee have given the subject serious consideration and in this report we have tried to embody first, the reasons why a movement of this kind should be advocated; second, how it should be attempted, and third, a plan upon which it may be formed. I will with your permission now go at once to the report.

REPORT OF SPECIAL COMMITTEE.

Subject:—"Advisability of Forming a Defense Association."

In considering the important question submitted to them by your honorable body, the members of your committee found themselves, from the beginning, of one mind as to the desirability of a protective organization formed within the membership of this Association. If no other arguments presented themselves, the single fact that our employes are organized into a vast and harmonious body, and the necessity of meeting organization with organization, would of themselves constitute sufficient reasons for the formation of such a league as has been proposed.

It is one of the commonly accepted ideas of the times that the average employer is not only utterly indifferent to the welfare of those in his employ, but that he is constantly seeking to invent new methods for enriching himself at their expense. Though numberless instances are in daily evidence to disprove this, the impression seems rather to gather than to lose force, and consequent distrust and animosity between those whose community of interest should impel them to mutual helpfulness are the rule.

To maintain what they consider their just position, workingmen, especially in our foundries, have long maintained one or more organizations, by the aid of which they have frequently conducted protracted strikes, the results of which have been not only directly injurious to all parties concerned, but have brought in their train a host of indirect disasters such as must inevitably follow any disturbance of peaceful relations, and by bringing to bear at times against a single shop the united influence of thousands

of their fellow workmen scattered throughout the country, as well as the active sympathy and encouragement of other thousands engaged in different lines of industry, they have been able to establish, locally and temporarily, false conditions, utterly unwarranted by the general state of trade or by any principle of abstract justice, and to impose grievous burdens upon the operators of the particular shop affected. That such a result has invariably and inevitably re-acted in time against its creators seems to have taught no lesson.

It requires but slight familiarity with the history of such disturbances in the trade to enable one to realize that difference between employer and employe more often have their origin in comparison than in actual and definite abuses. It is from contrasting matters in one shop, town or locality with those in another that disputes most frequently arise. That the abolition of this custom of "contrasting" would prove an unmixed blessing is evident, and it is equally apparent that such contrasting would be much more cautiously attempted under conditions which promised a complete representation of all parties concerned—the far as well as the near—in a thorough discussion and investigation of all the conditions bearing upon the question in dispute.

If the foundrymen of this country were to profit by past experience in their own and other lines of manufacturing, they would lose no time in perfecting an organization which would enable them to meet their organized employes as a body, thus adding strength and dignity to any arrangements that might be amicably concluded between all parties, and to any protest they might find themselves compelled to offer to unjust exactions. The advantages which such a body would have over the individual foundryman in treating with dissatisfied employes seem to your committee too plainly evident to require specific and detailed mention at our hands. One point which, however, cannot be too strongly emphasized is the value of the element of delay in preventing strikes. By far the greater number of disastrous strikes are suddenly declared, as the result of hot-headedness on one side or the other, and would be avoided altogether if a few hours or a few days for calm deliberation could intervene. A protective asso-

ciation, such as is suggested, could easily, by agreement with the employes' association, insure such delay by placing the settlement of all disputes in the hands of representatives of both the conflicting interests.

Moreover, such recognition and acknowledgment of each other's interests on an extended scale would compel that mutual respect so needful where perfect trust and confidence are requisite to the best results.

We all know that the greatest element of cost in manufacturing is the labor account, and while we may forecast with some degree of accuracy the remaining factors that enter into cost, we can never be sure that unexpected upheavals may not materially and indeed seriously influence the labor item. If all manufacturers were on an equal basis as regards the main cost of their product how much would it lessen the strain of that awful competition that is sapping the life of our business, tending to increase the commercial depression, and retarding the return of prosperity.

Being agreed then as to the desirability of a protective association, the first aspect of the question to demand consideration of your committee was that of practicability, and here, happily, we were enabled to profit by the experience of others, and to find ready to our hand a well-tried model, which, with some minor modifications, seems fitted to the purpose. The experiment has already been worked out and with results which give the most flattering promise for such an organization as we recommend. Actual experience has already met and surmounted most of the obstacles in the way of the successful working of such a body, and many problems which might have confronted us have been satisfactorily solved beforehand.

By the courtesy of the officers of the Stove Founders' Protective Association, your committee has been allowed to examine the workings of its plan, which has now been in operation for eleven years, and is enabled to declare that it is of inestimable value to its members.

Through the operation of this plan a bond has been formed so strong that, while the Association has protected its members from unjust demands, it has inspired the employes with such a

sense of the justice of their employers that it is now a fundamental principle to settle all disputes without the cost of a strike, and to adjust all questions of wages and methods by periodical conferences, in which all the conditions of the business are freely discussed and reason dictates the result. Whereas, before the formation of this Association, the stove founders habitually figured on extensive interruptions to business by reason of strikes, not a single strike of any consequence has forced itself upon the attention of the body referred to above.

It might seem at first that an Association of men engaged in various lines of the foundry business might be less easily successful than one embracing only a single line—as in the case of the stove founders—but further examination of the subject serves to dispel this fear. When it is taken into consideration that differences with our employes usually arise from their action as a body and not as individuals, and that these bodies are invariably made up of all the various classes of workingmen in our employ, there remains no doubt that the several branches of founding necessarily composing such an association as we recommend could always find some common line upon which to act in harmony and with beneficial results.

While the action by which this committee was created did not distinctly contemplate the consideration by it of a detailed plan for such an organization, we beg to outline the following suggestions to that end:

First—The object of the Association should be the mutual protection of its members, and the adjustment of all disputes with employes, with due consideration for the just interests of both parties to the controversy.

Second—The membership should be confined to principals in and operators of foundries where castings in iron, steel, brass or other metals are made.

Third—The working force of the Association should be vested in an Executive Committee selected from the general membership and in a District Committee in each of five or six districts into which the country should be so geographically divided as to

bring together those foundrymen in whose territory similar customs and conditions prevail.

Fourth—Each member should contribute to the fund of the Association a proportionate part of such sum as may be necessary to defray the working expense of the Association.

Fifth—An emergency fund should be created by special assessments on the members, in proportion to the number of molders employed by each at the time such assessment was levied. This fund should be held intact, for the double purpose of having on hand, at all times, ample funds to meet any demand upon the Association, and to create an added attraction, making membership more valuable as the fund increased.

Sixth—Every member should be free to settle on his own responsibility any dispute arising in his shop, but, having once invoked the aid of the Association, he should place the entire settlement in its hands and be required to abide by the decision reached.

Seventh—In case of dispute, every reasonable effort to settle it without a strike should be made, and if the employes refuse to consent and did strike, all the force of the Association should be brought to bear to give assistance to the member whose shop was affected, either by procuring men to take the places of the strikers or by compensating the member for losses incurred in defending the principles at stake.

Eighth—With these principles as basis, your committee believes that the detailed formulation of constitution and by-laws would be easily reached, and could be so adjusted as to work in entire harmony with the laws of the American Foundrymen's Association, thus placing within reach of the members of the latter the privilege of sharing in the unquestionable benefits of the interior organization here outlined.

W. H. PFAHLER,
WM. YAGLE,
E. H. PUTNAM,
Committee.

All of which is respectfully submitted.

I want to say in addition to this report that it was my good fortune this morning to find in this city of Detroit a gentleman who practically and really organized this Stove Founders' Defense Association. He was its honored president for ten years and he probably knows more about the question than anybody can possibly have acquired during his business career. By his consent I have obtained from him the promise to supplement this report with just a few words as to the experience of that association. With your permission I introduce Mr. Henry Cribben, of Chicago.

The President: We shall be pleased to hear Mr. Cribben.

Mr. Cribben: Mr. President and members of the American Foundrymen's Association:—I have been somewhat interested in listening to your discussion this morning on the apprenticeship question. I am a molder, one of the charter members of the Iron Molders' Union of America. I want to say to you now as a practical molder, not a stove plate molder, but a molder all around, that the day is not far distant when if some action is not taken by this body and by the body of which I am a member to make a better class of workmen in our foundries we shall live to regret it. It is a question of vital importance to all that we should educate our apprentices in a manner that will make them good and efficient workmen. That question I will leave. My friend here says I know more about the Defense Association than any man. I do not know why I should know more about it than he, for he is a member. Why should I know more than any other man who takes an interest in the organization? Our National Association of Stove Manufacturers in years gone by used to reduce the wages of their workmen and for every dollar they reduced the labor they gave the customer three. How long I would ask would it require to destroy the largest profit in the best business in the world if given away at that rate? In 1886 the molders of the country had become so arbitrary that it was necessary for the manufacturers to organize an association for common defense. They almost walked into our offices and told us how to conduct our business, not only in the foundry but in the office, and we thought it was

time to call a halt. We had an organization that had been in existence for years and one of the mistakes of that organization was the adoption of a resolution that the labor question should not be touched. We therefore had to organize outside of that association. The members in their judgment selected me as their executive. Having some experience as a molder and some as an employer I hesitated, but I had found the molder and his association ready for action. I found the employer ripe to conquer. Whenever there was a dollar to be made it has been the custom of the employer to forsake his companions and leave them standing alone. I have seen this and passed through it. I am an older man than I look, for I have been in business nearly forty-eight years. They wanted to know why I did not desire this position, and I told them. They said they were willing to do anything I asked them to do, and I asked them all to rise to their feet, and they all did so, and I then asked them to raise their right hands, and they did. I asked them to pledge their word of honor to always obey orders, and they did. I can say now, nowever, as their executive, that for ten years I never knew one of them to fail, not one. It was my object, when the organization was first started to try to bring about a peaceful solution of this question. And I wrote a long letter to the President of the Iron Molders' Union of North America, asking him to appoint a committee to meet a small committee on our part to see whether some better means could not be devised to settle these small differences as they might arise, and he gave me to understand that the employers' association in his opinion was no more solid than sand. I told him that sand might be changed to a band of steel. He laughed. They had made up their minds within six months from the time we organized to ask an advance of 15 per cent throughout the entire United States, starting with the Mississippi valley. We tried to head it off, and being a little afraid of my soldiers I was ready to offer them a compromise as we were still infants in the business. But they would not accept it, and so on the eve of a battle we had to organize our forces. This we did by sending the patterns of that struck shop into the hands of each member in that district. A week afterwards those same patterns were

in the hands of several members in this district, and every member shut down in the third and fourth districts excepting the Detroit foundries and we finally shut them down also. We then pushed the patterns forward into the second district and closed the foundries there. You will say "What did you accomplish by that?" We accomplished a great thing. There were some 400 on strike in St. Louis, and we put on strike nearly 5,000, without any visible means of support. We cut off their supplies. We saw we had to defeat them in a manner never to be forgotten and this state of things existed for about ten weeks, when hearing my men in Cincinnati were a little weak, I jumped on the train for that place and brought my friends together to try to strengthen our defenses. While sitting at the table in the hotel I received an invitation to receive the General Executive Committee of the Iron Molders, then in session, to see if some means could be taken to settle this strike. After reading the invitation I passed it to my colleagues and they wanted to know whether I was going to accept an invitation like that. Certainly, I said, and I asked whether one or two of them would not accompany me. None would; they seemed all afraid. I said I am going myself. So I went, and when they talked about the strike I talked of other things. I began to tell them how to run an organization as we used to run it. I told them that when we got beaten we would declare that strike off. They said, may be when you get ready to declare that strike off, we shall not be ready to go to work. I said "My friends, when you were in your swaddling clothes I was building this organization. I was engaged in two strikes and I never saw men that went hungry to a certain place that were not ready to go to work, if work were offered to them. It will be your place when we declare this strike off, which will be in about 60 to 90 days." Strange to remark there was not one of them that refused to go to work, and while I sat in that office five gentlemen came into the ante-room. One was the president of the Iron Molders' Union No. 10 of St. Louis. He looked as if he had ridden in a coal car. They were over there to beg for money for St. Louis and I said, "Gentlemen, I see here men that require provisions at your hands. They need money, I hope you have

some money to relieve their wants with." I offered them money enough to go back. The result was that at the next meeting of the International Union, held in St. Louis, they had more members in the ante-room than in the convention hall. They were all on the pay roll and they all had claims against the International Organization which the officers of that organization would not allow, and it came very near tearing the organization asunder. I have said all I wanted and do not want to take up your valuable time, but I want to just read to you what we have done. Do not forget to build up your emergency fund and do not take your organization outside of this body. You are just beginning operations.

Mr. Cribben at this point read the following extracts from the form of Organization of the Stove Founders' Defense Association:

"Its special object, as expressed in its Constitution, is 'to combine its members for resistance against unjust demands of workmen,' whether through labor organizations or not. For this purpose each and every member, on admission to the Association, pledges himself so long as he remains in the organization to two things: First, that any unjust demands by workmen shall be resisted by the united action of all members; second, that he will obey all lawful regulations of the Association. No interference between a member and his employes is contemplated, or provided for by the laws, unless that member specially desires and requests the protection of the Association and places the matter in the hands of its officers.

"Each member has, as well as the right of being protected, certain duties to perform: First, strict obedience to the Constitution, Laws and lawful regulations of the Association; second, the moral support at all times on labor questions of every member whose conduct to his workmen is reasonable, just and honorable; third, furnishing molders in case of strike, or in default a reasonable payment for each man not furnished; fourth, the active support of any member who is boycotted; fifth, payment of the expenses of the organization in proportion to his business; sixth, the continual augmentation of the 'Emergency Fund.'

"The Association has, since its birth, been called upon to fight several battles, and it has the proud record of never having been defeated. Its primary entry into the arena was in the famous 'Bridge & Beach' strike. In February, 1887, trade being not in any too favorable a condition, the molders of the Bridge & Beach Manufacturing Company, of St. Louis, supported by the Iron Molders' Union of North America, made a demand for an advance of 15 per cent in their wages. The demand was considered unnecessary and unreasonable and referred to the Association. It was decided to offer the men an increase of ten per cent to take effect the ensuing June, when it was considered that prices could be advanced to meet the increased cost. This the men refused and struck work, and after continued fruitless negotiations the patterns of the member were distributed to other members, whose men generally refused to make the work and struck, thereby closing the foundries. The Bridge & Beach Company, with the material and unqualified co-operation of the Association, engaged new men, put on a large number of apprentices, made their shop entirely independent of any union, and on May 30 were producing all the goods they needed. The patterns were recalled and the other foundries also resumed operations. The result of this strike was a loss in wages to the molders of $519,350; a loss to the mounters, polishers and other employes of $525,300, but a decided gain to stove manufacturers generally through the firmness in prices caused by curtailment of production, the unrestricted output of stoves that year being in such excess of the demand that if it had continued, as it probably would have done, prices must have fallen.

"In February, 1890, a dispute on certain matters arose between the Rochester Co-operative Foundry Company, Rochester, N. Y., and their molders. The shop had always been an open or independent shop, union and non-union men being employed. An agreement or contract between the molders and the firm had existed and was annually renewed to the satisfaction and benefit of both parties. That year the Iron Molders' Union of North America interfered to prevent the extension of the agreement, and at the same time caused certain demands to be made which,

if conceded, would practically have transferred the control of the business from the firm's managers to the molders' committees. The firm withdrew the agreement and attempted a compromise, yielding all that it was prudent to do, but the molders were headstrong and insisted upon all their demands. A strike was declared, but about one-half of the Union men themselves declared it unjustifiable, refused obedience and remained at work. These men were expelled from the Union and the strike continued. The protection of the Defense Association was sought and granted, a full quota of men supplied and funds contributed until October 1, when the Co-operative Foundry Company were in such a favorable position that all efforts in their behalf were suspended. The result was, to the Molders' Union decided defeat on every point, and to our member an independent shop with freedom from any sort of control or undue influence ever since.

"This closes what may be appropriately termed the 'Belligerent Age' of the Association's development. Thereafter more humane, civilized and reasonable methods have been possible, because of a change of policy on the part of the Molders' Union, and have obtained.

"During various interviews between the officers of the Association and those of the Molders' Union, the former deprecated the necessity of internecine strife forced upon them and expressed a wish that other and better plans of settling disputed points could be devised and enforced. Immediatey after the pronounced defeat at Rochester, Mr. Martin Fox, having deplaced Mr. Fitzpatrick as President of the Molders' Union, addressed a letter dated November 29, 1890, to Secretary Hogan, stating that a general convention of his organization had authorized the appointment of a committee to meet a similar committee of the D. A. for the purpose of 'arranging plans for future action, whereby questions of wages or other differences may be mutually settled without incurring loss or injury to the parties concerned,' and stating that such committee was ready to meet and confer with the D. A. committee at any time, to make arrangements to guide them in their future actions. President Cribben, under the authority of a resolution adopted in Detroit, in 1887, appointed a com-

mittee of five to meet the molders' committee, and a conference was held March 25, 26 and 27, 1891, in Chicago. The result was the adoption of resolutions providing that there shall be no strikes, no lockouts, but that all differences between the molders and their employers, when a majority of the former are members of the I. M. U., shall be referred to the presidents of the two organizations for settlement, and if they cannot agree, to a committee consisting of three members of each of the organizations. These resolutions were substantially ratified by the members at large of both bodies. Further conferences were held in 1892, 1893, 1894, 1895, 1896 and additional resolutions were adopted providing:

"1st. That the general rate of molders' wages shall be established for each year without change.

"2d. That each year shall commence on April 1st.

"3d. That the established prices of work in a shop shall be the basis for the price of new work of similar character and grade.

"All of which was ratified by the members at large of both organizations. All these resolutions are still in force. Under them there have been several cases decided.

"In March of 1893 the officers of the I. M. U. made a demand for a general advance of prices throughout the country of 15 per cent. A special meeting was called to consider this and refused to grant it. The molders demanded a conference, which was held in May, and the increase was again refused. Subsequently their committee appeared before another meeting of stove manufacturers, but the refusal of an increase was still persisted in, and none has been granted.

"This completes the history of the organization to date. It is a recital of a series of successful contests unbroken by one single defeat, repulse or compromise. It has never taken up an unjust or questionable case; therefore, it has deserved to win."

I want to say here that we have passed through four years of the greatest financial depression ever known in this or any other country, and the stove molders of this country have not been reduced one dollar except on the Ohio river and one other place.

I want to say further that our Stove Association profits in the business have got to such an era that we dare not make any foolish move as we have in the past, or all the profit in the business would be wiped out. I understand you are making castings at prices running from $15 to $20 per ton. I do not see much money in that, There is no more money in that than in the stove business. You do not want to come together purely for social enjoyment. You want to come together for practical purposes, purposes that tend to make your business profitable. I know there is not a man here who has come simply to have a nice time. What you should do would be to put your theory into practice, commence first with yourselves and then by influence with each other. Stand together like men, be determined, maintain your positions and satisfy yourselves that there will not be one ton more castings made and sold at $15 than there would be at $32. It is this spirit of competition that annihilates all the good. Instead of it being a pleasure to do business, it is really arousing a feeling of regret that you are obliged to do it. When a man picks up an article and says "It cost me 25 cents and I have to sell it for 20," there could not be much in that kind of business. I know you are doing that to a large extent. It would have been well if all the business men had maintained the selling price as well as the labor price for the past four years. We have not had an average variation in wages of 3 per cent. We are ready to embrace Mr. McKinley's agent of prosperity as soon as he comes, and we want to make some money out of our business. Are you in that condition now? I think not. You will have to begin to raise up. You will have troubles all around in the shops, labor strikes, etc. I say this that the interests of the employer and that of the employed should be identical, and if you can advance the selling price of your product with the aid and assistance of your labor, you can afford to compensate that labor as well as compensate yourself with additional profit. We have found this to be true at rather a late day.

At the conclusion of Mr. Cribben's address the convention adjourned.

OUTING ON DETROIT RIVER.

On Tuesday afternoon the Entertainment Committee placed the steamer "Promise" at the pleasure of those attending the Convention. Nearly all the visitors took advantage of the chance to observe some of Detroit's beautiful surroundings. The party aboard were first taken a distance up Lake St. Clair, and on returning a trip was made down the lower part of the river towards Lake Erie.

The Entertainment Committee had stocked the boat well with refreshments, which were liberally patronized during the trip. Upon landing the members were notified that a session would be held at Harmonie Hall during the evening.

TUESDAY EVENING SESSION.

At the evening session no routine business was transacted. James A. Beckett, superintendent of the Walter A. Wood Mowing & Reaping Machine Co. at Hoosick Falls, N. Y., read a paper on "Cupola Practice—Melting and Controlling Mixtures of Iron."

CUPOLA PRACTICE—MELTING AND CONTROLLING MIXTURES OF IRON.

JAMES A. BECKETT, Hoosick Falls, N. Y.

There is no single item of foundry practice to-day, which is of so much interest to the practical foundryman, as that which I have selected for the subject of this paper. From the revival of the art of casting iron in the early part of the sixteenth century, down to the present time, the practical melter and his employer, have watched with ever-increasing interest the evolution of each theory which has been put forward, and the perfection of each improvement in furnace construction, which promised, even in the most remote degree, to enable them to secure more uniform results in the production of castings.

While the search for a solution of the difficulties which prevented the attainment of even a partial uniformity of results, was conducted upon the basis of a superficial knowledge of the phenomena resulting from faulty practice, practical success was well nigh an impossibility, and at best could only be attained by men of large experience, and of more than average ability and intelligence, who were able in an imperfect way to grasp the situation, and by carefully watching and thoughtfully considering every symptom of disorder, apply such remedies as experience suggested. How imperfect such practice was, so far as it related to the matter of melting iron in the cupola, is best evidenced by the works of the early writers upon this subject, in which matters which are now well understood through the researches of the past twenty-five years, are treated as a mystery; or, they are made the subject of ridiculous guesswork, and, in the latter case, some of the remedies given for troubles which are now known to result from the most flagrant violation of natural laws are in the form of a mysterious compound, under the name of a patent flux; a nostrum which was warranted by its discoverer, to soften iron for stove plate, to increase the

depth of chill on car wheels and to make engine castings close-grained, soft and tough, no matter what kind of iron was used in making them. Then, in more recent times, the older foundrymen will remember the advent of a class of men who pestered the foundry owner, until he was induced to try their secret mixture of iron; a mixture, which was, of course, only known to themselves, by the purchase of which the foundryman would be able to make so much better and cheaper castings than his neighbors, that he would be able to control the entire foundry trade in his section.

It is needless to say that his expectations were never realized, and that, in some cases, it took several years to work off the last of that wonderful mixture. In those days, the professional melter was the most important figure in the foundry; but, as the real value of his work came to be fully understood, the need for his services disappeared, until to-day, the professional melter is pretty much a picturesque memory, and his place is being filled by the man he looked down upon (from the scaffold), the hard-working foundry foreman.

The adoption of coke as a fuel in melting iron in the cupola, was one of the first important improvements in cupola practice. While good anthracite coal is, in some respects, a purer fuel, there are limits to its use; it is only good when used in short heats; on account of the infusible character of the ash of this fuel, it is practically impossible to even partially clean out the cupola while melting, as is frequently done with coke; so that, when melting with coal, the limit of the heat is the length of time it takes to produce a sufficient quantity of refuse matter to bung up the cupola. The use of coke made it possible to melt more iron in a given time and with less fuel, because from the peculiarity of its structure, it could be more readily converted into gas. A belief that there should be a more perfect combustion of the gases, led to a number of experiments being made in this country and in Europe, which resulted finally in the introduction of an additional supply of oxygen into the cupola at the melting zone, by means of an upper row of tuyeres, which,

through the operation of well-known natural laws, makes the combustion of the gases more complete.

The saving in fuel and increased efficiency resulting from the adoption of the type of cupola which bears the name of the late Victor Colliau, of this city, would, if there were no other considerations, entitle his name to a place upon the honor roll of the heroes of industry, whose peaceful victories are no less renowned than those of war.

For the purpose of this paper, I shall take the Colliau cupola, which was perfected in this city some twenty years ago, which in its various types and changes, has practically marked a new era in cupola practice, preferring to leave the newer and later systems of melting (which are yet more or less in the experimental stage) to the consideration of those, who, by reason of a greater familiarity with them, are better qualified to speak of their merits.

After several years' experience with the Colliau cupola, in various sizes, I am led to believe that the best work can be done with a cupola having a 6-foot shell, lined up to the door with two courses of good arch fire brick, which will give a thickness of lining of 9 inches. Above the door, one course of good arch fire brick 4½ inches thick will be sufficient, if properly laid and supported by suitable angle irons bolted to the shell, to sustain their weight when the lower lining is being repaired; they will last as long as the shell of the cupola lasts, provided that instead of the usual solid door, lined with bricks or clay, a door of wire screen is used, which will keep the sparks from getting out on the charging floor at the end of the heat, and will admit the cool air to enter freely and cool the brick work in the upper part of the cupola.

The bricks used in the inner courses of the lining at the melting zone, should be selected for their refractory qualities. Above the melting zone, the bricks should be hard enough to withstand the wear and tear of the stock in passing down to the melting zone.

The size of a bed of coke for a cupola of the size given, which would have an inside diameter of 54 inches, must depend largely upon the kind of coke used; the kind of iron melted, the character of the work to be poured, and the character of the blast used, whether it is obtained from a fan or from a pressure blower.

For light or medium-sized heats, the fan gives good results, and is largely used; but for larger heats and more economical working, in my practice, the more positive pressure blower has given more satisfactory results. If the blast pipes are in good condition, the number of cubic feet of air per minute, which the blower is speeded to deliver, must pass through the cupola, which makes it certain that as great a volume of air enters the cupola during the latter half of the heat when the pressure increases, as there did in the beginning of the heat, when there was less resistance to the entry of the blast.

For the purpose of this paper, we will assume that the pressure blower is used, which is sufficiently large to deliver about 6,000 cubic feet of air per minute, which should give an average pressure of about twelve ounces. For ordinary medium-sized castings, the bed of fuel for a Colliau cupola of the size given, should be 1,800 pounds of good coke, which should have at least 10 per cent of ash, and which should not exceed one per cent in sulphur. This amount of fuel for the bed will make a safe starting point, which may afterwards be changed by more careful work.

In this type of cupola it is not necessary to follow the old rule of making the first charge of iron three times the weight of the fuel in the bed; upon a bed of coke of the size given, 6,000 pounds of iron may be charged. If sprues and scrap are used in this charge, they should be put in in such a manner that they will melt no faster than the pig iron; this will not tend to increase the speed of melting, but it will make more uniform castings than if the sprues or light scrap were charged directly upon the coke. This rule should be observed throughout the heat.

The second charge of coke should be 500 pounds, followed by 6,000 pounds of iron, in the same manner as before, and so on to the end of the heat, making the last charge of coke 100 pounds less than the others or increasing the last charge of iron 1,000 pounds, as the heats may vary from day to day. This will give a ratio of 1 of coke to 10 of iron, in a heat of 36 net tons, and the average speed of melting after the first iron is taken, should be about 14 tons per hour. When a foundry is equipped with the most modern appliances for distributing the melted iron, and particularly when running on a uniform product, in which the castings are not too thin, the melter may, gradually, increase the amount of iron in each charge to 7,000 pounds, or he may vary the amounts of coke and iron, after the bed, in such a manner, as, in his judgment, the working of his cupola demands, keeping the proportions 1 of coke to 14 of iron after the bed. This should be borne in mind, as when the amount of fuel in the heat is reduced to its lowest safe limit, it is seldom found that two cupolas will work exactly alike. The ratio for the charges last given would be 1 of coke to 12 of iron, in a heat of 55 net tons.

If it is found that a ratio of 1 of coke to 14 of iron after the bed, is sufficient for the work to be poured, the blast pressure can be increased to 13 ounces; the speed of melting will be increased and the iron will be hotter than if a lower pressure is maintained.

Those who have been content with the average ratio of 1 of coke to 7 or 8 of iron, may be inclined to think that there would be but little prospect of success with the fuel ratio just given; but it is not by any means the limit of good practice in melting iron in this style of cupola, as it is based upon the work of a foundry which makes castings, many of which are full of cores, and which range from an ounce to 125 pounds in weight, and where the melted iron has to be carried an average of 200 feet to where the lightest work is poured.

In this foundry a heat of 55 net tons of iron with the last fuel ratio given, and a blast pressure of 12 ounces seldom takes more than three hours from the time the first iron is taken,

unless it is necessary to reduce the speed of melting near the end of the heat, when the molders are unable to pour the iron as fast as it melts.

The reason why I count from the time that the first iron is taken, is because there is so much difference in the manner of starting the cupola in the different foundries doing the same kind of work; some prefer to light the fire early and let the bed get well started to burn before charging the first of the iron, and then, after the cupola is filled, it is allowed to burn until a few minutes before the iron is wanted, when the blast is put on; by this method the iron is melted very quickly after the blast is put on. Others light the fire with just enough coke on the wood to make sure of a good start, and after the small amount of coke charged has taken fire, the remainder of the bed is put in, and the iron and coke charged in until the cupola is filled, when the blast is put on at once and gradually increased until the iron commences to run. There is considerable difference of opinion as to which is the best plan. I prefer the latter method after considerable experiment with both plans, as I have found that with the large bed of coke which is necessary in this style of cupola, there is greater economy in putting on the blast gradually, as it is not so severe on the fresh fuel, and I have found that I have been able to melt more uniformly, both as to speed and the heat of the iron throughout the entire heat, than when I used the other method; so that, for some time past, we have only put on enough blast at the beginning of the heat, so that when the iron commenced to run, it will be hot enough not to foul the spout of the cupola, and when the cupola is stopped up, we increase the blast pressure to the desired limit, and let it remain during the rest of the heat. I don't want to be classed among those who believe that everything must be sacrificed to a low fuel ratio in melting iron, for I don't believe that there is any economy in saving a few pounds of fuel at the expense of several dollars worth of castings; at the same time, I would advise every foundryman who thinks that there is room for improvement in his practice, to study well the principles

which govern the combustion of fuel in the cupola, and to consider well every contemplated improvement. Above all, avoid making radical changes, as nothing is gained by such a course. All that goes into the cupola, both fuel and iron, should be carefully weighed and each charge of iron or fuel carefully leveled up before the next is put in. When making changes in your system of charging, it is well to take notes of whatever occurs during the heat, for future reference; such data may prove very useful in determining the cause of variations from one day to another; or, in the way of determining future changes.

When the limit of successful melting is reached, the melter who has been using too much fuel, will find that the less fuel he uses, the softer his castings become, and that, as a rule, he can use more good scrap or No. 3 pig iron to produce castings to conform to a certain standard of working qualities than before. This is where the real benefit of a low fuel ratio comes in, and if the time should come when the price of iron reaches the average of seven or eight years ago, the advantage of using a larger proportion of No. 3 iron in a mixture will be even more apparent than it is now.

I have no doubt that many members of the convention have noticed the difference in the character of the castings produced from a given mixture of iron, when the ratio of fuel to iron is high, say 1 to 7 or 8, and when the ratio is low, say 1 to 10 or 11. I have been so situated for several years, that at intervals I have had an opportunity to study this difference, with different mixtures of iron. The result has always been the same; a mixture which yielded good soft castings at 1 to 10 or 11, invariably produced hard castings at the end of the second or third heat, when the fuel was increased to 1 to 7 or 8, and when we changed back to the old fuel ratio, the mixture of iron could be changed back to its original proportions. The difference must be chargeable to the burning out of some element necessary to produce softness in the iron, to a greater degree, when an excess of fuel is used, than before; the same difference is noticed when from improper charging a given mixture of iron is melted at a slower

rate than it should be with the same volume and pressure of blast. The melted iron passing down more slowly through the bed of fuel, is subjected to the action of the blast for a longer period, and the castings made from it will be harder than they should be, if the iron was melted more rapidly. The result is the same in both cases—a loss of silicon greater than is necessary in good practice.

I think that you will find that the loss of silicon affects the casting in this way, each unit of silicon in the iron exerts an influence upon a certain amount of the carbon which the iron contains, keeping it in the graphite state; when a unit of silicon is burned out of the iron, the carbon, which under its influence was retained in the graphite state, combines with the iron, increasing the hardness of the casting, increasing the shrinkage or contraction, and creating new and unforeseen strains in all irregular forms of castings, making their very strength an element of weakness. Added to this is the uncertainty of producing a given result, and the increased cost of labor and expensive tools when such castings have to be machined, which unnecessary expense and trouble can all be avoided if more care is exercised in the melting of the iron, through a more intelligent method of dealing with the various details of cupola practice, founded upon a better understanding of cause and effect, and a common sense application of the principles which govern good practice.

There is no single item of foundry practice which has so prominently engaged the attention of practical foundrymen for the past four or five years, as the matter of controlling mixtures of iron, through the aid of chemical analysis; this question has been discussed pro and con in all the leading iron trade journals, until it would seem to have been worn threadbare; but in spite of the prediction of those who were wedded to rule-of-thumb methods, the idea has steadily gained ground, and each year sees an increase in the number of foundries which have adopted this method of securing uniformity in the character of their iron, and among those who have taken the matter up systematically,

are included many who at first were most skeptical as to the benefits to be derived from the adoption of the new system.

When dealing with this subject, it must be admitted that there were some grounds for the opposition which the introduction of this theory excited. There has been a great change in the views of those who advocated this change in the beginning, as a comparison with what was written several years ago, which our present experience will readily show. Many of the ideas or theories which were laid down as cast-iron rules, have been relegated to the scrap heap, because of the results obtained by a more mature experience.

There is no more conservative class in the world than the practical foundrymen; they look with distrust upon those—even of their own class, who are in favor of introducing changes. It is not to be wondered at, therefore, that when the young student of metallurgy, who, as a graduate from some good technical school, had been selected to assist in improving the work of the foundry, sailed in with a confidence born of three or four years' speaking acquaintance with his subject, and endeavored to show the practical founder who had done good work since before he was born, that he was all wrong, and that his salvation depended upon his studying certain tables, formulated by some fellow whose name he had never heard before; it is not to be wondered at that he refused to study, and almost invariably requested the theoretical gentleman, in a manner not entirely consistent with the rules of common politeness, to go to a place where the climate is popularly supposed to be so hot, that even cast iron would be in a state of perpetual fluidity.

To-day, the theoretical and practical sides of the question are getting closer together, and our practical men are being awakened to the necessity of throwing prejudice to the winds, and adopting any common sense method which will promise to relieve them of the expensive uncertainty.

In calling to our aid the services of the chemist, it is not necessary to ignore past experience of a practical nature, for unless the knowledge gained by practical experience is called to

our aid in selecting samples for the laboratory, the results obtained from the analyses will be of little use. Where it is customary to have a supply of each kind of iron used in the mixture, in the stock yard, it is a good plan to take each pile of iron by itself, select by fracture a number of pigs which, in the founder's judgment, will most nearly represent the average grade of that particular pile, and use them as a sample, drilling into the center of the fresh broken end of each pig with, say a half-inch drill, to the depth of half an inch, being careful not to get any of the sand or dross from the outside of the pigs into the drillings, as this would make the sample worthless. The drillings, when mixed thoroughly together, are to be wrapped in strong paper, labeled, and sent to some reputable chemist. It is not necessary for each particular foundry to have a laboratory or a chemist; nor would I advise anyone to attempt to do their own work in an amateur way, as I believe that there is as much depending upon the skill in manipulating an analysis in all its stages, as there is in knowledge of the proper methods; therefore, it is better to have the work done at a laboratory which is engaged in such work on a large scale, because there it is generally done by the most improved methods, and the reputation of the chemist in charge is at stake when the result of his work is questioned; hence the work of a reputable chemist, is, in the long run the most satisfactory, even if it does cost a little more.

By treating each lot of iron in this way, and using the resulting analyses as a basis to make a mixture for the particular class of work required, a greater degree of uniformity will result, provided that in taking the iron from the pile for each heat, the melter will keep the average grade upon which the sample was made, constantly in view; that is, he should try to have what he takes from the pile each day represent a fair average of the grade of the pile. To the practical melter this is not so great a task as it would seem to those who are not familiar with the handling of pig iron; far from it; it is simply combining the best feature of the old practice of judging the iron by fracture, with the new practice of determining the extent to which an iron

can or should be used, by a knowledge of the truth as regards what it contains.

This method of sampling has stood the test of several years, and will, I think, give a greater degree of uniformity in the product, for a small outlay, for chemical work, than any method which has come to my knowledge. One of the greatest obstacles in way of the adoption of chemical analysis as a basis for making mixtures of iron for the foundry, in the past, has been, careless or unsystematic sampling. Unless the sample fairly represents the characteristics of the pile of iron from which it is taken, it is useless to try to depend upon the analysis made from it. In the same way samples of fuel should be made. If coke is used, a small piece may be taken from the sides of the large lumps at intervals of 18 to 24 inches over a pile or carload; these should be pounded in a cast iron mortar and the dust carefully made up into a package, labelled and sent to the chemist for analysis. When it is suspected that the coke contains an excess of sulphur, traces of which will frequently be seen in the black ends of such coke, it is safe to include in the sample to be analyzed, enough samples of the black ends to fairly represent the average of that kind in the pile or carload. Good coke for foundry purposes should not exceed one per cent in sulphur when soft castings are desired, and we should have as much less as we can get, and when melting large quantities of iron, a coke which contains less than 10 per cent of ash is apt to prove too soft to bear the weight of the iron.

In buying coke with which to melt iron, it is a safe prediction that the best is none too good, and will prove the cheapest in the end. A ton of coke will melt several tons of iron; if a coke which contains 0.75 per cent of sulphur will produce with a mixture of No. 2 irons, castings which are satisfactory in every respect, and a coke is substituted which contains double the amount of sulphur, it will be necessary to use nearly all No. 1 iron of the same brands, even when using only the sprues and scrap made each day, to make castings which will be as satisfactory as when the No. 2 mixture and purer coke were used. The difference

in the cost of the iron alone, shows that we cannot afford to use poor fuel if we get it for nothing.

When accurate analyses of the iron and fuel have been obtained, the next step to be taken is to decide what shall be the standard for the new mixture. I know of no better way for the beginner than to select one or more castings which have proved to be entirely satisfactory; take drillings from them and take the analysis of the drillings for the basis upon which to proceed. In calculating the silicon for a mixture it is safe to allow at the outset at least 25-100 more than there was in the casting which represents your standard, to make up for furnace changes, and I have known several cases where it was necessary to allow more. The phosphorus in the mixture should be left the same as in the casting, and unless you are making special work with which it would interfere it is safe to have it from 0.50 to 0.75 per cent because of its tendency to increase fluidity and diminish shrinkage. Unless you use irons which are low in silicon, no special attention need be paid to the sulphur in your pig iron; as a rule, irons which are high in silicon are low in sulphur; in fact, the conditions which tend to increase the silicon contents of an iron in the blast furnace, have a tendency to diminish the sulphur. For similar reasons the manganese content of a mixture of ordinary foundry irons, plays an unimportant part; it does not often exceed 0.75 per cent, and is more frequently about 0.50 per cent, and at that proportion it does not interfere with the working qualities of good gray iron castings, whatever may be said of its influence upon iron in some of its other forms or conditions.

Having arranged the proportion of the different brands of iron which will best give the desired per cent of the four elements before named, you can estimate the value of the sprues and scrap resulting from the previous heat, if it is not convenient to have a sample taken from those analyzed, and by having an analysis made from a sample which will fairly represent the product, you will have a starting point from which you can depend upon getting fairly correct results.

At this point I want to say to those who propose making this change in their system of making mixtures of iron, that they must not be discouraged if the first confirmatory analyses which they get, does not fully meet their expectations in every respect; repeated trials, aided by a common sense application of the experience gained in a practical way, will show you why you have failed in the first attempt. Remember, that every difficulty surmounted by patient investigation, leaves you better equipped to contend with the next difficulty which confronts you.

In controlling a mixture of iron made upon the basis of its chemical analysis it is not usually necessary to watch closely any of the elements which it contains except the silicon and the sulphur, particularly the latter. Silicon is the most variable constituent in iron, but fortunately its influence is such that a change of a small fraction of a per cent is not readily detected by any physical test, if the other elements remain constant. Phosphorus has been considered the greatest element of danger in iron on account of its baneful influence upon malleable iron and steel, in all its forms, due to its tendency to promote crystallization; cast iron being of a crystalline structure, and not being subject to any treatment which tends to change that structure from the conditions which were produced by the process of casting the metal. There is no reason to fear the result of using sufficient phosphorus to aid in imparting fluidity to the iron, except in some special cases, but for ordinary work, 0.75 per cent of phosphorus in the mixture will, when the silicon is in the vicinity of 2.25 per cent make a softer, sounder and stronger casting than if the silicon alone is relied upon for fluidity. Aside from its tendency to promote fluidity in the melted iron, phosphorus decreases shrinkage or contraction; the benefits to be derived from this characteristic in a mixture of iron, in the way of reducing the amount of initial strains in irregular forms of castings, is now being recognized by those who are engaged in such work, and in many other instances, irons containing a liberal per cent of phosphorus are being selected by founders who have no knowledge of their chemical contents, because the cast-

ings made from such a mixture are less liable to break when subjected to shocks.

Sulphur may well be considered the foundry man's "bane"; there is no doubt that it is responsible for more of the troubles which occur to impair the quality of the casting, than any other element contained in ordinary foundry iron. Sulphur promotes an increase of shrinkage and hardness by its tendency to facilitate the increase in combined carbon. If asked to name two of the most common troubles to be met with in foundries making ordinary gray iron castings, I would answer, hard iron and blow holes; these two troubles are the most common and at the same time the most difficult to contend with. Unless the cause is well understood, sulphur is usually to blame for both, making the iron harder by increasing the per cent of combined carbon, and by its tendency to make the melted iron sluggish and full of gas, which can be seen to escape in small puffs as the iron cools in the ladle; it makes it practically impossible to make castings free from blow holes when 0.10 per cent of sulphur is present in the casting.

Sulphur is rarely found to exceed 0.060 per cent in ordinary foundry irons and is usually less than half that amount, so that it is to the fuel we must look, as the principal source of danger. Good foundry coke should not exceed 0.75 per cent in sulphur; with such a coke there would be no trouble in making soft castings; but such coke is not as easily obtained at present as we could wish, so we have to increase the limit to 1.00 per cent, and even at that, some unscrupulous dealers will endeavor to run in an occasional carload of coke which is so high in sulphur that it will harden the softest mixture of iron that we can get; in such cases, the benefits of chemistry are beyond computation, since by giving us the per cent of sulphur in the fuel and in the product the cause of the trouble can be decided beyond question, and the proper remedy indicated.

In melting iron with coke, it is necessary to provide a flux which will impart fluidity to the ash of the coke and make it run off the top of the iron in the form of slag. Limestone is

most commonly used for flux at the rate of about 40 lbs. to the ton of iron charged into the cupola. The lime beside imparting fluidity to the refuse matter in the cupola, has a tendency to absorb the sulphur from the iron as it drips down in melting through the slag, which floats upon the melted iron in the bottom of the cupola; if this slag is even slightly basic in its character, it assists in removing the sulphur from the iron. And again, the deleterious effects of sulphur may be somewhat counteracted by increasing the percentage of phosphorus in the mixture; not as some are led to suppose, by removing any part of the sulphur in the iron, but by increasing the fluidity of the metal and prolonging its life in the ladle; it affords better opportunity for the gases to escape, and the slower rate of cooling seems in a measure to correct the tendency to abnormal contraction in the casting.

These suggestions are made with a view to aid the beginner in correcting troubles which are most commonly met in the average foundry. It must be borne in mind, however, that in the beginning, and until the founder has thoroughly gone over the ground covered by the range of his work, changes should be carefully made, and each contemplated improvement carefully considered.

Much harm has been done in the past by founders jumping at conclusions without sufficient experiment. It must be also borne in mind that while in a measure, certain chemical contents in a mixture of iron produce certain physical results in the casting, a material change in the proportions of the different elements in a mixture may produce widely different results from what is intended, unless the reasons are fully understood. The term material change, will have to be understood as differing widely in proportion, when it is used in connection with the different elements. What would be a material change in the sulphur, would not be sufficient to be noticed when phosphorus or manganese is considered; and what would be a material change in the proportion of the two last named elements would

not, when applied to the silicon, seriously affect the result. The founder will also have to bear in mind that although a change in the proportions of certain elements will produce good results, a further change in the same direction will often lead to a return of the previous condition. It has been noted by those who have to deal with castings of irregular form, that there are certain combinations of silicon and phosphorus which will produce perfectly sound castings, when they would otherwise be porous or spongy, and that a further increase of one or both elements, would result in the spongy or porous spots appearing again in the same manner as before.

To the beginner, the matter of making mixtures of iron on the basis of chemical analysis, is likely to seem a more formidable task than it really is. The fact that mixtures of iron have been successfully made by simply estimating the extent to which each kind of iron could be used, goes to prove that extreme nicety of calculation is not absolutely necessary to success. With the exception of sulphur and combined carbon, there is considerable latitude for change in the variable elements contained in the mixture, before any serious trouble will be experienced. After the founder has learned to figure out his mixture on the basis of the analyses of his stock, with a liberal allowance for furnace changes, if he is careful to keep his method of charging the cupola, the volume and pressure of the blast and the rate of melting, as nearly uniform as possible each day, there will be, if the stock has been properly sampled, but little chance for variation in the product which will affect the physical character of the casting. When he has reached that stage, he must constantly bear in mind that the character of the product from a given mixture depends upon keeping the relative proportions of the different elements practically the same while the mixture is used. He must also bear in mind, when making changes that the influence of the different elements which affect the working qualities of the iron, is not always the same, but varies as the proportion of that element varies in the mixture. He must learn that an excess of silicon produces hardness above 3.5 per cent;

that above 1.00 per cent of phosphorus produces weakness, that when the sulphur reaches .05 per cent, it is likely to make the casting hard, and, to increase the tendency to blow holes; that the manganese in a mixture for castings, which have to be annealed, should not exceed 0.75 per cent on account of its tendency to interfere with the conversion of the carbon at any heat below the melting point.

When the limits of what is safe for his particular class of work have been once established in his mind, he will be able to take care of any changes which occur by simply submitting a sample of whatever is abnormal in his product, to his chemist, who will put him in possession of the truth with regard to the trouble so quickly that expensive mistakes may be avoided, and the necessity for tedious experimenting entirely removed, and the experience gained in tracing out errors in this way will make the correction of each succeeding variation a much easier task than before.

The number of analyses made in the beginning, will, of necessity, be much greater than after the value of the work has been more firmly fixed in the founder's mind, and my own experience leads me to believe that after the first year the cost will be so small that it will not be worth considering.

As a matter of economy, making mixtures of iron from analyses is a good investment, because, in any foundry, doing even a moderate amount of business, one case of trouble with the iron will cost more than the necessary analyses for a year's work, when to this is added the greater degree of uniformity, and the freedom from serious variation, and the ability to use stock which is closer to the limit of what is actually needed, which enables a foundry to buy cheaper than when a higher factor of safety is necessary, it seems to me that it is to the advantage of every foundry man who consults his own best interests, to investigate this matter thoroughly, and adopt it as far as the character of his work may warrant. It is not necessary in adopting this method of making mixtures of iron, for the foundry to buy iron on a guaranteed analyses, as that would tend

to increase the cost of the stock; while I firmly believe that in the near future all foundry irons will be sold by analysis, such is not now the case, and only a comparatively small number of furnaces furnish their customers with a reliable analysis of the iron which they sell. What is most necessary now, is a better knowledge of what the iron contains, and a sufficient familiarity with the proper methods of applying that knowledge, so that we can make a mixture suitable for our needs from the irons which we can buy the cheapest; when we reach that point we will be independent of any particular brand of iron, and should be able to effect a considerable saving as compared with former methods.

As has been well said in the past, there is no such thing as bad iron; all iron is good for some purpose if its quality is accurately determined. All that is needed by the founder who bases his mixture upon its analysis, is that the furnace or selling agent furnish a reliable analyses of the iron sent in any shipment, and the melter can do the rest. This relieves the maker of the iron of all further responsibility in regard to the use of the iron, and from many of the vexatious troubles which are now of daily occurrence; it also relieves the melter of a great deal of anxiety, which under the old system was almost, if not entirely, unavoidable, and more than all this, when any trouble arises, it finds him in a position to determine accurately what the cause of the trouble really is, and when that is known, the remedy is easily applied.

In conclusion, let me say that the whole subject may be summed up in a few words. We have arrived at a point where the trend of progressive foundry practice is more than ever, in the direction of a search for truth in regard to making mixtures of iron for foundry purposes. The experiences of the past have proven the unreliability of the old system, when accurate results are desired. We have experimented long enough to know that in order to meet the increasing demand for greater uniformity in our product, we must have some better guide to aid us in mixing irons than a grading which is based upon fracture alone.

Close competition is compelling us to relinquish one by one, the prejudices of the past, and to call to our aid the truths which science has revealed to us, ignorance of which has led us into all the troubles of the past. With these truths before us, no backward step must be taken. The achievements of the nineteenth century have made it a safe prediction, that the march of improvement will still go on, and the foundryman who desires to keep up with the procession, will have to give more attention to the study of scientific methods of dealing with practical foundry problems.

The Chairman: The paper is now before you for discussion. It deals with one of the vital questions of the foundry business and it would be desirable if some of the gentlemen here would express their opinions on the subject. Mr. Ferguson is here to-night, perhaps he will say something.

Mr. Ferguson: I will say that I fully appreciate all the facts contained in this valuable paper and can agree with Mr. Beckett thoroughly, in regard to a cupola practice pertaining to an establishment that is doing one grade of work, but there are other requirements for the cupola. As applied to the general and jobbing foundry the straight lines laid out by the paper cannot be adhered to. The requirements of many foundries all over the country call for several grades of iron to be taken out of the cupola during one heat, and when the heats are not very large, either. I have known instances where a 10-ton heat has been divided up into half a dozen special grades, and owing to the various grades of scrap we necessarily have to handle in a jobbing foundry and get rid of, it is not always possible to charge the cupola with the regularity we should wish. The pieces to go into the heat, or the quantity of fuel to use, are measures and conditions which present themselves every day. As to the aid of chemistry under those conditions I worked with it a while, but with very little success, and I hardly see where it is possible to bring it into use under those conditions. We must still, in a foundry of that kind, be guided as in the past.

Mr. Bell: I do not know that I can add anything to this question. These are new ideas and I belong to the old school, the old regime. I appreciate, however, the valuable information given to us by the people who have taken up the question of chemical analysis. I think it is the coming knowledge that is to better the foundry condition. I do not know that I can ever avail myself of the full knowledge that these gentlemen possess, but there are others that certainly can and no doubt will be greatly benefited by it. Our old ways are very much fixed in us. We have learned a great many hings in the old-fashioned way, and they are probably as valuable as the information these gentlemen are acquiring more rapidly than we did. We should like, of course, to take advantage of these new things, and there is nothing in the advancement of the foundry business but what we are deeply interested in. I can only congratulate this Association on receiving and hearing read so valuable a paper as we have had this evening.

The Chairman: We have a gentleman present of the old school who might give us his experience with the new methods, and also give us his experience with chemistry. I allude to Mr. Devlin.

Mr. Devlin: We place ourselves in the position of patients. We have a doctor and we go to him and get the things necessary to set us straight. We have a chemist, and we depend upon him to furnish us formulas for our charges, and I believe that since we have employed one we have had very little trouble, and that any trouble we have had we have been able to explain. We are satisfied with the result of hiring a chemist, and are satisfied to go to the expense of having one continually in our employ. I, like my friend Mr. Bell, am one of the old timers that have got young notions, and I think for the best. I was very much pleased with the paper read this evening, and as far as I know all the ideas it contains agree with my experience exactly. We make both malleable and gray iron castings, and in the past have had a good deal of trouble with our malleable castings, and when trouble did come we would blame it on the iron, on the coal, and

again on the men who charged the cupola. We knew we had a trouble, but could not tell what it was. Now we can tell accurately just what the trouble is. We employ a chemist regularly and depend on him, and if he were here he could tell you more than I can.

The Chairman: Is Mr. Lanigan here to-night? Mr. Groves, what do you think of the paper?

Mr. Groves: I did intend to rise to ask a question. For many years I have taken an interest in cupola practice, and tried nearly all the various forms of linings and tuyeres. There was one phase of the paper that struck me very forcibly, and that was chiefly with regard to the sulphur. When that paper is published and we can sit down deliberately and read it, we shall find that the section referring to the influence of sulphur in the foundry will be of particular value. Take the average foundry in the country, where the class of work made would not pay to keep a chemist, or where they are compelled to use as high as 60 to 70 per cent of scrap, you may get all the chemists in the world, but of what advantage will they be in regard to all that old scrap? If you use say three tons of scrap, and hardly two pieces will correspond, what could your chemist do? With regard to the sulphur in the coke, our Mr. Taylor, of Pittsburg, has a very practical method of determining almost the exact percentage it contains. Instead of paying a fee for an analysis he simply takes a bucket of water and places samples of the coke in the water, and in a little while the sulphur rises, producing a yellow color, and soon the percentage of sulphur in the coke may be told in a rough way. It is a simple, practical, and first-class method, and one I would recommend any time you want to find what sulphur you have in your coke. There is a gentleman here to-night who has, I believe, a solution of the trouble in certain cases. There is a class of scrap we have in this country which we can hardly use, and we can get it for a song, so to speak. Take grate bars, old furnace fronts, etc., and begin to use them in your cupola and your cupola will become choked up. Scrap in a mysterious way has a remarkable affinity for sulphur, and what-

ever there is in your coke to excess you will find when you have that class of scrap it will develope wonderfully when you get it in your ladle. At times you can hardly stand by your ladle, so strongly does it smell of sulphur. Supposing you take a class of iron and get from 11 to 12 tons tensile strength per square inch, the gentleman I have spoken of will take the commonest class of pig iron and use 80 per cent of this common grate bar and furnace front iron, considered practically useless, and by a patented process he has he will bring that metal out of the cupola with comparatively none of the effects in the ladle which you have in the old way, and will guarantee to give 11 to 12 tons tensile strength. I saw this method some months ago before it was introduced in England, where the patentee has been among the iron people and many institutions have taken it up. If that gentleman is with us to-night it would be well for him to give us some idea of the process. I allude to Mr. Doherty, of Sarnia, Canada.

Mr. Doherty: Mr. President, I hope you will excuse me to-night, as I am not prepared to go into the matter. At some future time I shall not mind giving a full explanation of it, not only as far as my own ideas are concerned, but I will give you the scientific ideas of men in England who claim all the titles possible for education to bring them. The process has been before them for the past five months, and it has been thoroughly tested by all these men, experts appointed by the government. I shall be pleased to give an explanation at some future date.

President: The Association will appreciate most highly any future contribution bearing on this subject for publication in our transactions.

Mr. Buckwalter: I think I have hardly anything to say, as I am not a real practical foundryman. I am the manager of a concern running both foundry and machine shop, and we trust most of these matters to the foreman in the foundry. I listened to the article with a great deal of interest, but, as a gentleman remarked, I think it is applicable to that class of work where heats are of large capacity, and would not apply particularly to smaller

heats of a miscellaneous character; that is where all kinds of iron scrap and pieces are used.

Mr. Frank: If the formation of this Association last year had resulted in nothing else than bringing forward the paper by Mr. Beckett this evening I think that formation was well undertaken. I listened to that paper with a great deal of pleasure. It agrees very closely with experiences of our own. Ours is a young concern started practically only four years ago, so we are only in our swaddling clothes. When we built our foundry and machine shops we recognized that we were going into competition with the foundries of the United States, old established firms of reputations, and fortunes already made, and it was necessary to instil into our new concern such life and knowledge of melting and business affairs connected with the foundry that we appreciated chemistry would play an important part in economy. We have had the subject in view, and concluded that chemistry was probably a solution of the question of making proper castings. Stimulated by the newspaper discussions and what we could gather in the line of chemistry, which was crude in the foundry business, we instituted numerous experiments. We were groping, as many others were, in the dark. We appreciated that we had much to learn, and found many things in our experiments entirely contradictory apparently, but a closer study convinced us that what appeared as contradictory was confirmatory. It was like after knowledge of the subject. The paper of Mr. Beckett hammers in that idea very thoroughly. It is the lack of going into the subject and getting such pointers as Mr. Beckett has given us this evening, that makes the subject so hard, but once grasped it is a simple one. Expressions by people who operate jobbing foundries seem to occasion doubt about chemistry playing an important part in their work. We do heavy work, but it is necessary to produce light castings as well. It is sometimes necessary to produce many kinds of irons in a small heat. It is a knowledge of the use of chemistry and the change which takes place in your cupola that will enable you to do that very thing. In our business we find it an advantage to buy iron containing as high

as .275 per cent of sulphur, at which proportion most foundrymen would condemn the iron as bad. We find it excellent, and use it for a specific purpose, as in a manner of a homeopathist. It is the small doses which effect the cures. We use iron very high in silicon. We sometimes use coke with four per cent of sulphur; at other times we use coke as low in sulphur as we can get it. It is the knowledge of the medicines that you use that will enable you to use chemistry in jobbing foundries. I consider the paper Mr. Beckett presented is food for thought at once. It has brought forward many of the things which appear contradictory in the use of chemistry and made them clear. I recommend that you all read it again and study chemistry, and you will get good results.

Mr. Metcalf: In Mr. Devlin's remarks he stated that his concern hired a chemist and depended upon him to make their foundry mixtures. I know of a foundry in Pittsburg where that idea was practiced six years ago. They employed a chemist and wanted him to make good castings, and asked his advice as to what a good casting was. He did not know, and they put him in the foundry to run the foundry. Mr. Devlin's remarks would make me think that it was necessary to employ a foundry chemist all the time and give him work continually. We have not done that. We have had numerous tests made at very small cost. Mr. Groves said he wanted to know what he should do when he used 60 to 70 per cent in scrap. Last week I had occasion to make a particular heat, and looked over the scrap pile—forgot all about the pig. I did not have just the proper kind of scrap I wanted. On referring back to our chemical analyses made in the past four years, and referring to our scrap pile and records, I found that by using 95 per cent scrap and 5 per cent of pig metal at about $12 per ton, we were enabled to get just what we wanted.

The President: We have a place where we make all sorts of castings from bench molders work, so many to the pound, to some pretty heavy ones. We have the chemists so thick around the place that we can hardly melt, but we run six to eight differ-

er qualities of iron out of the cupola. From the bench floor we get any quantity of gates. In other words, we keep a record of the percentage of gates from the castings. We have learned to pay a great deal of attention to what the gates consist of, and they are sorted as carefully as anything else. We have very little trouble in making our castings. We do not do much jobbing, but the character of our castings vary considerably. We have probably 20 to the pound, at one end of the floor, and at the other there is apt to be 5 or 6 up to 8-ton castings. There may be among them a pot for a chemical works that has to stand heat. So you can realize the scope of mixtures that come out of that cupola at the same heat. To bring this about we must have somebody to indicate what we should do and what mixtures we should use. We have such a man, and he is kept extremely busy. He has the run of the yard and knows what a pile of pig iron contains, and he indicates that to the foreman, and he keeps a book of the heats he makes from day to day. At first they thought it was red tape, but we cannot now stop.

Mr. Beckett: I do not know that I can add very much to what has been said on my side of this question. In answer to Mr. Groves, I would say that it is possible to determine what the value of scrap is in a mixture of iron by applying the knowledge which is gained in practical experience in sampling that scrap. Go into the scrap yard of the average foundry and I should be surprised if there is less variation between the different pigs in a pile of a thousand tons of one brand of iron than there is in the variation of your scrap of the same amount. It is only by trying to establish in your minds by the knowledge which your experience in handling iron has given, that you can make a sample which would save you from having numerous analyses made. I have before now used up a lot of five thousand tons of iron without having a single confirmatory analysis made from stock, for the simple reason that the stock was used practically with the same end in view. That is, that a certain average of stock represented the grade, and we tried to take so much every day. It is possible to do that with scrap if a man has a long experience as a practical melter. If he does not know anything about the chemical con-

stituents of the scrap, he has to determine its value by an examination of the fracture. Suppose he does that, and having done it finds what represents the average of that pile, and has it analyzed, I think you will agree with me that the knowledge gained in that way will have a practical value. It is possible to run more closely. Take it even in the foundry doing business where, as Mr. Ferguson says, you have to use three, four and five different kinds of iron out of the same cupola in a small heat. If those charges are more carefully made, then you can possibly estimate the value of component parts of the charge and the results should be so much more beneficial. In writing this paper I have had in view the hardship which would result if small foundries were obliged to employ the services of a chemist exclusively. They naturally could not afford to get a man whose work would be of real value to them, so that in advising foundries, that would come to me for aid in this matter, in a quiet way I have sent them, invariably, to the best chemist I could locate in their locality, and advised them to stick to his work. I know from my own experience, before we employed a chemist, that there are foundries where from the character of their work they did not feel able to employ a chemist. They have been enabled to get along cheaper by employing a chemist to do what analytical work they needed to control their mixtures than if they didn't employ a chemist at all. I have two to three foundries in mind now that I know are running on work that varies. For instance, there are three classes made in the same foundry, one class is as light as what might be termed light novelty work, small castings requiring a high finish. Another grade is of such a character that it has to be annealed 48 hours to make it soft enough to be machined rapidly. They have another class of heavy machinery work that ranges from 10 to 1,000 pounds. They melt in the same cupola. The other day I had a letter from the manager of the foundry who went into this matter with me, because he was one of the boys promoted from the ranks, and has the most successful department in the works where he finally was given the position of general manager. He knew nothing of iron, was a machinist, a good mechanic and a bright man. He came to me to get such infor-

mation as is practically the substance of this paper. He came several times, and I went over that matter thoroughly with him, and it was necessary after he returned to his home to write three or four letters on matters he did not fully understand. For the past year his work has been so satisfactory that he has not had to consult anybody. In the meanwhile he has been obliged through circumstance to allow his foundry foreman to go where he could get more pay, and he took a man off the floor, a man of no experience, took him up and put him in charge of the foundry. They are doing good work, and for a year they have not been obliged to consult anybody about anything. Before they were practically at the mercy of the man who sold iron. In that foundry I was asked to give them, in a course of consultations, what in my opinion would prove of the greatest advantage to them in getting more uniformity in their work. I told them of the plan we adopted to determine the value of our stock, and knowing the troubles they had from time to time I advised them to put themselves in touch with some good chemist in their locality, and have him analyze their stock and use that analysis for a basis for the mixture. A man then temporarily in charge was skeptical as to the results; in fact, he ridiculed the matter so much I was obliged to drop it. Eight or nine months afterwards I was called on by the foundry to determine what was the matter with some castings they had. Next morning I was asked to make a mixture on the basis of the analysis of their irons. I did not know anything of them and had to depend on experience gained in a practical way. I found one pile of iron they depended on as a scrap carrier, a nice, big, open-grained iron, with a scale almost as large as the nail of your little finger, and when analyzed it contained only one and a quarter per cent of silicon. The phosphorus was almost down to the Bessemer limit, and the only remarkable thing about it was that it had about one and a half per cent of manganese. You can readily imagine how much scrap it would carry. Another brand of iron, some 500 tons, was sold to them for No. 2 iron. One end of the pile which was supposed to be the softest averaged 2.85 in silicon. The iron they supposed to be the hardest on account of the closeness of its grain

contained four per cent of silicon. These figures are from an average, taken from a block of 100 tons, using a sample of 60 pigs for an analysis. Now when iron varies as much as that when graded by fracture it seems to me that it will be necessary to have a better knowledge of what it contains than we can get from the fracture. When I was given the foremanship of the shop I had worked in for 14 to 18 years, I did not know anything about iron, only how to do the work given to me when I was there. When I undertook to look after the melting of the iron, I was just as much at a loss as a man could possibly be. I tried to find out what people who had been melting knew, and I had not much success, and began to inquire among the foundrymen of my section, and was surprised to know that beyond the familiarity of the look of the end of the pig they didn't know anything more about it than I did myself. They knew that iron of certain appearance was good for a certain quality of work, but they could not tell why. Trying to see if there was a better way than this, through the courtesy of some friends, I went to Pittsburg, and looked over the steel works, and saw what was done there in selecting irons for making steel, and it struck me at that time, 1889-1890, that the foundry trade of this country was bound eventually to adopt some such methods in selecting the grades of iron for melting in the cupola in order to secure uniform results. I have kept along on the ideas given you to-night in this paper, and while results have not been at all times as satisfactory in the latter years of my experience, still I believe I have been learning something all the time, and have endeavored to improve on that knowledge by practical experience. I think the trouble in the adoption of chemistry in the first place was largely due to the fact that some young chemists in their zeal supposed that practical experience was absolutely worthless. I am not inclined to think so, but if you combine the two in a common sense way, with the view of getting the best good out of both systems, you will get nearer correct results.

The President: Mr. Penton, I would ask you whether it is not practical to take the transactions of the preceding year containing the papers of this Association and bind them in a loose paper cover for issue to the members.

Mr. Penton: Our transactions of last year, as you know, have been published every month in separate numbers, so that six numbers make a volume. We then leave it to you to bind them yourselves, and it is practicable to do so. They are paged and numbered with that idea in view. Any one receiving our monthly transactions can readily have them bound. Many members bind them and keep them, and the matter of binding them can be arranged with a local binder. In this connection I may say during the last few months the Journal has become more popular, and seems to be considered a work of reference. Members missing a copy will write for it in order that their volumes may be bound complete.

The President: The paper of this evening then will be issued in the next number. The reason I call attention to this is that I have heard some remarks made by the members that they had not the full issue of the transactions, and of course we realize now that these papers are becoming more valuable, and that the desire to have a complete file increases.

Mr. Keep: I do not believe the members of this Association realize what that journal is worth. I know something of it because I value it. That journal not only contains the papers published by this Association, but it contains every month a digest of every paper on foundry work that can be found. Mr. Penton from his exchanges selects all the papers on foundry practice, and digests them, and notifies you where they may be found. It seems to me if you look at it rightly that this is the same kind of a journal that the Iron and Steel Institute publishes, and the best to have in our libraries. I know from several conversations had to-day that the value of the journal is not appreciated as it should be.

The convention then adjourned until Wednesday morning.

WEDNESDAY MORNING SESSION.

The proceedings opened with the announcement by the president of the appointment of a defence committee, as follows: W. H. Pfahler, William Yagle, Alexander Jarecki, Ed. Maher, E. H. Putnam, H. M. Leland, J. F. Lanigan.

The President: The first business is the report of the committee on the amendment of the constitution I find, however, that the committee is still in session. We will therefore go to the next business in order, which is a paper by Mr. Knight, entitled "The Value of Chemistry in the Foundry."

THE VALUE OF CHEMISTRY IN THE FOUNDRY.

By S. S. KNIGHT.

The subject which your secretary has chosen for me, that of "Chemistry in the Foundry," is one that I am glad to have the privilege of discussing before the Convention of American Foundrymen, since American foundrymen, as compared with those of other nationalities, stand at the head of their profession.

I am thankful to have the opportunity to present to you a question which in the foundry business has so great a bearing on profit and loss and which, it seems, judging from the few foundries containing chemical departments, has never been brought before you with its full significance, has never been treated as a financial investment; in brief, has never been shown to be a question of dollars and cents. My purpose this afternoon is to present the plain facts of the case in the simplest manner possible, and to adduce from them such conclusions as naturally follow.

In speaking of chemists in this paper, it will be understood that more is implied than men who have merely a theoretical knowledge of the subject. The fact is that theory alone is the smallest part of the requirements of an iron metallurgist. Commercial interests demand men of practical worth, not those who can analyze only, but those who can use their analytical and synthetical knowledge to cheapen and better salable products of commerce.

The cost of installing and maintaining a laboratory is generally the chief objection to the application of chemical knowledge to foundry work. This cost, as a rule, is greatly over-estimated. To my knowledge, one of the best laboratories that could be wished for was put in at a cost of less than $1,000. For all ordinary foundry work $100 worth of chemicals and $300 worth of apparatus will answer and will, if placed in the hands of a competent, practical man, pay one hundred per cent profit on the investment in one year's time. As to how this can be, will now be examined in detail.

Since iron is the chief material used in foundry work that will be considered first.

As is well known, most furnaces grade their iron upon fracture, since most of their customers will have no other means of judging its quality when received. I have known of Southern iron which was close, when advised as 2 soft to be rejected although it contained over four per cent of silicon and no other elements in objectionable quantities. Here certainly an analysis would have been a great advantage to the receiving foundry. On the other hand, we have known the same firm to take an open large crystaline iron as 2 soft when it contained less than one and eight-tenths per cent of silicon and nearly two per cent of phosphorus. Here again a laboratory would have proved of great value and would have, in this case, saved many castings.

When you consider that only two elements can be even approximated by physical or mechanical means, then the importance of chemical facilities becomes extremely plain. An excess of phosphorus and sulphur may ruin a casting just as easily and surely as a deficiency of silicon. In much work it is far more dangerous. Castings which must withstand heavy strains or acid action must not exceed a prescribed limit in either of these elements. If metal be required which shall have special properties, how else but by chemical means can these be determined? Thus acid castings have been found to require about one per cent of silicon, five-tenths of a per cent of phosphorus, five-hundredths of a per cent of sulphur, and three per cent of carbon. By experiment and analysis it has been found that architectural iron should run about as follows:

Silicon—Nine-tenths of a per cent.
Manganese—Three-tenths of a per cent.
Combined Carbon—Sixty-five-hundredths of a per cent.
Graphite—Two and five-tenths of a per cent.

Such metal has been made by careful analysis and computation of constituent irons which would stand a tensile strength of 40,000 pounds to the square inch section, and so that when exposed to a two per cent solution of sulphuric acid for twenty-four hours at sixty degrees Fahr. that less than seven-tenths of one per cent dissolved. To attempt to mix such iron as that by frac-

ture, in the face of what has been shown concerning the fracture and the reliance that can be put upon it, would be supremely absurd.

Some shops are at present using soft iron tools—tools cast from iron instead of steel. It may seem strange to those not connected with chemical work, that the irons used in making tools, which are frequently high-priced, make no better tools than common machine borings, providing an ore preferably spathite be used for a flux.

Coming back to the question of economy. Is it cheaper to use high-priced irons and mix by fracture or to use low-priced "off grade" irons and mix by analysis? In many instances I have known fifty cents a ton to be saved in this way alone, and in one special case, one dollar and fifty cents a ton. But what is far better than the saving in cost of material, is the certainty with which the product is manufactured.

If a chemist be conscientious, and thoroughly inspect every thing brought in, the cost of establishing and maintaining a laboratory for one year will be paid in two months. The scrap should be analyzed and then there can be no question as to how much scrap a mixture can carry. Often much of the trouble that is placed to the credit of the scrap really is caused by the coke. I once saw a large shop lose casting after casting without being able to detect the cause of the trouble. The mixture was changed, but still the iron was bad. Analysis of the coke settled it all for it contained two per cent of sulphur. For this coke they were paying seventy-five cents a ton more than was subsequently paid for a coke that contained less than one-third of that amount. The difference was caused by the establishment of a laboratory. They were using forty tons a day of this coke, so on the first price alone the laboratory paid for itself in half a month. Another thing that must be watched is the ash of the coke. If more than ten per cent is ash, then you are paying just so much a ton for dirt. The ash of coke can only be told by analysis, and likewise the phosphorus. Both are detrimental if existent in large quantities. Here again is a saving which may be credited to the laboratory. While considering coke let me say that quite a portion of

the product now on the market is the so-called dead coke. After the flame has left the fuel and the coal has been properly burned, it is no uncommon thing to leave the coke still in the oven in order to retain the heat for the next charge. This, of course, greatly deteriorates the quality of the material, but by its appearance it is impossible to distinguish this from the good coke. In available heat units, however, the dead coke may be fifteen or twenty per cent below the good product. Here we see another saving which the chemist only can make.

Coming to the subject of coal, you are all acquainted with the price that is usually charged for coal suitable for the forge. By analysis it is found that this high-priced coal is almost identical with a lower grade and a saving of forty per cent may be inaugurated in the cost of this necessity. A furnace coal which was used in a certain shop was analyzed and found to be less than ten per cent as efficient as a lower priced coal, and practical boiler tests calculated in horse power and pounds proved the correctness and practical utility of chemical advantages in this case.

And next we come to fluxes, and slags in cupola work. Here is where chemistry scores another decided point, in reducing the amount of flux used and the character of the slag obtained. By the analysis and appearance of the pig metal, the chemist can tell how much and what kind of flux to use. In most cases none is needed since the ash of the coke is sufficient to carry off all sand and impurity, but if trouble is found in dumping the cupola, a few shovels full of lime-stone may be added to the last dozen charges. In most places where laboratories are available no spar is used and but little lime-stone. This, of course, could not be done with safety where chemical knowledge was not utilized, since on one brand of iron it might work well, while on another it would cause trouble. The saving in lime-stone occasioned you will note, and like all others will be great, just in proportion to the amount of work turned out.

Concerning sand, we would say that here, as in all other products consumed, a great saving will be occasioned by the use of chemical science. The carbonacaceous material is of no value, while the contents of alumina and silica is of the utmost impor-

tance. Too much clay is very bad since the mold will not vent properly on account of being too compact. If facing or sea-coal is being used on the molds, clay will make the castings scab, and thus ruin them for the market. If such should be the case, the use of molasses water as a menstrum for mixing the blacking instead of clay wash will remedy the trouble. Again the analysis of the blacking is of great value. You may be assured that no facing will give satisfaction if its fixed carbon is below eighty per cent, or if it carries over ten per cent of volatile hydrocarbons. It also must be refractory, or if not and used on heavy castings, it will burn off, causing scabbing.

The analysis of facing will save many castings from the scrap pile, and thus directly bring about a saving of no little importance.

Since most of the graphite used is made by the fusing of iron with ground carbon instead of from the mineral, foundries have to constantly be on the look-out for high iron-ash in this material, which greatly increases its weight, and decreases its value. As graphite is sold by weight, you will at once recognize where the laboratory again masters the situation and I have known a saving of no less than thirty per cent in cost alone to be due to analysis, while the salable product was greatly augmented in quality.

Coming now to the less important substances, such as brick, fire-clay and lime. All of these substances should be tested by the chemist. Since the brick in a cupola are usually quenched at a high heat, it is important that they do not readily absorb water. If the water enters the pores of the brick, it will, when vaporized, tend to break down its structure and disintegrate it. Samples may be taken and heated before the blow pipe to one thousand degrees or even one thousand and five hundred degrees Fahr. and be quenched, thus duplicating the condition to which they are exposed in actual use in the cupola. This should be done before buying, and the purchase made in accordance with the observations made in the laboratory.

Fire-clay may be mixed and dried and then treated in the same manner. Lime should be analyzed and that having the

most calcium oxide taken. No lime is cheap that contains less than ninety-five per cent of pure lime. The magnesia content should be low. Insoluble matter is of little importance since in any good article it exists in so small a quantity. By the use of these tests, I have known ten per cent of the cost price to be saved, which in large shops readily amounts to significant sums.

The saving on oils and such necessities, although they are not used in enormous quantities, yet in a year's time will be noticed. I recall an instance where a fifty gallon drum of gasoline had been purchased graded as eighty-seven proof, the hygrometer test showed it seventy-four deodorized, and thus caused its rejection. In that one case forty per cent of the cost was saved.

And so one might go on and point out place after place where a laboratory in the hands of a competent chemist would save expense, but the examples of the utility of chemical knowledge which have been shown should be amply sufficient to convince even the most skeptical that no foundry, unless very small, can afford to be without one. In these times of competition, when every article is reduced to the lowest possible figure, and every avenue of expense so materially decreases the profit of the manufacturers, the quality as well as the price of every purchased article must be carefully watched. Besides this, many firms are requiring in their specifications the analysis of the salable product, so that being without chemical advantages in this age only means the inability of the firm to compete on many articles. Gas plants and chemical works, which are being erected, are furnishing a large quantity of work for foundries, and can only give their orders to plants furnished with chemical facilities, since they must have their castings of an approximately definite composition.

Alkali kettles, flanges, fittings, digesters, retorts and acid boxes all must be made according to the composition presented in the specifications, so that only those places which mix their irons by chemical analysis can compete for this work.

We must also consider the certainty with which mixtures are made in foundries that employ competent chemists. The percentage of loss is very small in such foundries, and any difficult

work may be undertaken with nearly a certainty of success. The satisfaction which this method gives may be judged from the fact that a single instance has yet to go on record where a laboratory was installed and a competent chemist employed that ever subsequently did away with their chemical department. This is a most significant fact and speaks more for the efficiency of the laboratory than any thing else could.

Before concluding, I wish to call your attention to the fact that all of the larger corporations in the foundry, as well as in all the other branches of manufacturing industry, have risen to and maintained their places in the commercial world, in more than nine cases out of ten, by the employment of scientific knowledge, and not unusually has this knowledge been either directly or by implication of a chemical nature.

The blindness and ignorance of the past are no criterion by which to judge the requirements of the future. The time is not only approaching, but is already at hand, when any foundry that expects to do more than a local business, must necessarily be equipped with all the advantages of modern times, not among the least of which are chemical facilities, so that they may not only be able to buy the best material for the lowest price, but also that they may operate with the least waste and turn out the finished salable product of the best quality and in the shortest time.

Mr. Viall: I do not think that I am competent to add anything to what has been said. I most thoroughly believe in the ideas set forth in the paper. I never had the advantages of a scientific education, and our company have never fitted up a laboratory. We, however, employ chemists for many purposes, and have done so for some time. I am fully in sympathy with the paper.

Mr. T. D. West: I am delighted with the paper read by Mr. Knight, and I believe the day is not far distant when it will be impossible to do without a chemist in the foundry. The paper states fully the various lines in which chemistry can be profitably employed. There is one element in chemistry at the present time

which has held it back somewhat, and I think there should be some radical steps taken by this Association to effect reforms in that line, and that is right at the doors of the blast furnace. I do not want to be thought of as coming down hard on the poor blast furnace men, but we are located near to and surrounded by blast furnaces. I see a good deal of their operations, and we know from experience that there are a great many things which could be reformed in their practice. Before leaving for the meeting here, I had to call up a furnace man to know what was the matter with his iron, as it did not turn out to be what he had claimed for it, as a one per cent silicon iron. Our chemist found it about one-fifth. He said perhaps a few pigs had got into another pile. I told him those pigs had been getting in that pile for a dozen or more shipments. It is well known that there are no two parts of a furnace cast that will analyze the same, and the first part is generally lower in silicon than the last part. It is useless if correctness is wanted for them to take just samples from the last part of the cast and analyze them, and then report the analysis as covering the whole. An analysis of that kind discourages chemistry. Foundrymen who are back numbers, laugh at the progressive fellows as they call them, and when they receive an analysis of that kind, how can they be expected to do otherwise than ridicule chemistry. They find the iron does not agree at all with the analysis. That is one example, and it shows what error has led to. The blast furnace man in being particular to take a general average of his cast believes what he reports to the foundryman is true. Mr. Knight covers that ground very fully. Not long ago we went through an experience in re-analyzing our irons. We found that they did not agree and was radically wrong. We found out that some fellow in marking the pig iron piles had made a mistake, and got the wrong piles marked. It would give the "back number" another chance to laugh at the progressive fellow. There are a dozen cases which go to impress us with the fact that there should be some systematic effort made by furnaces to grade their iron properly. Some time back I presented a paper before the Foundrymen's Association of Philadelphia along that line. I wish more im-

portance had been attached to that paper. Never until we take some radical steps in that line are we going to find ourselves on the right track and force the world to acknowledge the value of chemistry.

The President: I would incidentally make a remark as to the importance of chemistry. I am acquainted with the manager and metallurgist of a large steel plant, and they were making a kind of cast steel for certain purposes, and the steel was getting worse and worse, and they did not know the trouble. They analyzed before and after, and so on. Finally they discovered it was caused by the change of plumbago in the crucibles. The percentage of carbon had changed entirely, and really made a product anything but what was intended to be made. How could that be discovered in any other way but by analysis? We will now have a paper by Mr. J. A. Walker on "Crucible Making and How They Should be Cared for."

CRUCIBLE MAKING AND HOW THEY SHOULD BE CARED FOR.

By JOHN A. WALKER, Vice-President of The Jos. Dixon Crubible Co.

To the last half of the nineteenth century—just closing in such a blaze of metallurgical and industrial glory—belongs the Graphite industry; so much so, in fact, that graphite has become one of the great factors in our modern civilization.

To speak *mineralogically*, graphite belongs to the coal family and is classified with the carbon minerals.

To speak *chemically*, it is a pure carbon and has substantially the same analysis as charcoal and the diamond.

To speak *geologically*, it occurs only in the oldest Archaic rocks and is the product of an unmeasurable heat.

To speak *electrically*, it is one of the best conductors of the subtile electric current.

And, to speak *colloquially*, it has entered every civilized home in the form of stove-polish for the kitchen, and the lead pencil for the library.

It has revolutionized metallurgy by its use in the making of crucibles or melting pots.

As a mineral it crops out all over the globe, but as an ore of a suitable quality, and in sufficient quantity to pay for mining and refining, it is confined to three or four well-known localities.

The most notable product of the graphite industry for foundrymen is the Graphite Crucible, or melting pot, hence the subject assigned to me is "Crucible Making and How they Should be Cared For."

Crucibles or melting pots of some description have of course been used since the first fusion of metals by man. We all know the legend, that the earlier alchemists marked their crucibles with a cross (hence the word "Crucible") to prevent the devil from interfering with the chemical operations about to be performed. This legend, whether true or not, shows the antiquity of the melting pot.

Before the present century, crucibles were made chiefly of sand and clay, but what we know as the modern Graphite Crucible, more commonly known as plumbago, or black lead, was originated in the year 1827 by Joseph Dixon, then living at Salem, Mass. So it is to the present century, and to an American that the world owes this useful invention.

In its broadest sense, a crucible is the vessel in which a fusion of some substance is conducted. Crucibles differ widely, according to the substance to be fused and object of the fusion. They differ in composition, shape, and size from the tiny platinum crucible of the laboratory and the average melting pot for brass or steel melting, to the fifty ton hearth of the modern steel furnace.

Crucibles are used in every laboratory and every scientific shop, but chiefly in the foundry for the fusion of metals and alloys.

There are now in use in various parts of the world, platinum crucibles for laboratory work, sand crucibles, so-called, made from Hessian clay and sand, straight out clay crucibles made from English clay, and the melting pot known to all foundrymen as the Black Lead or plumbago crucible, which is, more correctly speaking, the Graphite Crucible.

While the use of the Hessian sand crucible still lingers among assayers, and while English steel makers still cling to the use of the one heat clay crucible, the vast bulk of all the metals and their alloys is fused in the modern graphite crucible.

As before mentioned, graphite crucibles were first made in 1827 by an American. Later the American taught the Englishman, and still later the practice traveled to France and Germany, Japan and China, and now, to the best of my knowledge, the making of the Graphite Crucible is confined to France, Germany, England, Japan, China and America. America, however, has taught the world.

The theory of the graphite melting pot is that, vastly better than anything else, it is a ready conductor of heat, and at one and the same time, it is both strong and elastic. Again, it is refractory and durable. Being the best conductor of heat, the coal bill is minimized, and quick melting possible. Being strong and elastic, it stands all reasonable shocks and accommodates itself to radically different temperatures. Being refractory, the

most stubborn metals succumb and become fluid long before the walls of the pot show the slightest sign of collapse.

The making of crucibles is based on a well defined theory and the crucible making plant should be under the sharpest supervision of its manager and his trained assistants. They must be possessed of the latest knowledge of metals and their alloys, of furnaces, of fuels, of fluxes, and of the mechanics and the chemistry applied by the people who use their crucibles.

A successful crucible maker must make constant chemical analyses of his materials, and he cannot have too much knowledge of the broad lines practiced by his customers.

The fusion point of different metals is vastly dissimilar. This must be taken seriously into account. For instance, the crucible made for steel melting is useless in a brass foundry. It is far more refractory it is true, but if the brass melter employed a crucible intended for steel melting, it would slowly wither away in his lower temperature while it would behave beautifully in a furnace with heat 1,000 degrees Fahrenheit higher.

Intimate knowledge of fuels and their function is also absolutely necessary to the crucible maker. He must know not only the behavior of the several fuels; as coal, coke, or gas, and perhaps electricity, but also the quality of these several fuels, as not only a change from coal to oil, but a simpler change of from one coal to another has an intimate bearing on the life of a crucible. Then, what suits one melter does not seem the best for another working under apparently like circumstances. To illustrate: A customer of the Dixon Company once complained of poor results in his large foundry and insisted the fault was in the crucibles. We were convinced that it was not, as his results were uniformly poor, so we proposed to him that we take from the same batch and the same kiln burning, 200 crucibles of the size he used, divide them into two shipments of 100 each, he to receive one shipment, we to send the other 100 to a shop of like renown, and doing similar work, and exchange results. This was carried out to the letter. Four weeks later when both sets of 100 were used up, reports showed that in the other foundry the average was 42 64-100 heats, but in his foundry the best run was 18 heats, while the average was between 14 and 15 heats.

This seemed to be knock-down proof that the crucibles were not only all right, but that his practice was either bad, or his fuel unsuitable, or the crucibles not adapted to his work.

Again, the crucible maker should know of the nature of the fluxes used, and try to be informed of the crucible users' preference in fluxes. These fluxes chiefly attack the binding materials in the walls of the melting pot. To some fluxes these binding materials are impervious, to others they are an easy prey. To illustrate again, it is an every day occurrence in our office to get letters inquiring what we know as to the effect of this or that substance on the walls of the crucible, and last week a metallurgist called, and after telling his wants in the way of a special crucible, and listening to our explanation of what we could do, paused a moment in thought, and then said: "Well, shall I change my flux, or will you change your crucible?"

Again, by slow and almost unperceived steps a very large use of the more fusible alloys has come, and come to stay. The market demands denser and stronger castings, and for this the fusion must be much more fluid. Hence the rapidly increasing use of Phosphorous, Aluminum, and Manganese.

The use of these alloys not only adds strength and density to the castings, but promotes the fusion and increases the fluidity. This raises the question of the porosity or permeability of the wall of the pot.

If the crucible with these extra fluid fusions is not well chosen, or should it contain hair line cracks invisible to the naked eye, this very fluid mass will find such cracks and prepare the way for a leak. While we are convened here, the British Iron and Steel Institute are in session in London, and the topic of one of their papers is "The Permeability of the Wall of the Crucible." In brief, the day has passed when a crucible is simply a crucible, or when one kind will suit all fusions, all fluids, all fluxes, and all furnaces, or to change the putting of it, there are graphite crucibles and graphite crucibles. It is not sufficient that the mixture carries graphite; the crucible must be specially adapted to its particular service.

So much for Crucibles and Crucible Making. We must now turn to the other half of my subject, viz.: "How they should be cared for," by which is undoubtedly meant how the user should use them.

First let me emphasize and iterate and reiterate that the value and life of a graphite crucible depend as much on the treatment it receives as on its own intrinsic quality. Last month we sent a special crucible to a New York brass founder for trial to verify a new purchase of graphite. In due time the worn out shell came back with a note saying 42 heats, but the customer added: "You must not expect this good result in regular work, as I supervised the trial of this pot myself," thus unconsciously emphasizing the difference between his handling and other handling.

In using a graphite crucible the first step is the annealing. When the crucible comes from the maker's kiln, where the temperature is very high, it is supposably bone dry. It is, however, a porous vessel and it easily absorbs moisture, hence it should always be stored in a "bone dry place."

I have seen crucibles stored in a shed where both rain and snow came through cracks and broken windows and the crucible maker hundreds of miles away was "called down" later on because the pots "scalped."

As to annealing, both too little stress and too much stress can be laid to it. The best annealing is even heating, that is, evenly warm the pot, not on one side only, but around the pot, to a temperature say between 250 degrees F. and 300 degrees F., and maintain that heat there until all moisture is expelled. Nothing more is required except equal good attention should be given to the even cooling all around of the pot.

Four weeks ago a customer repeated his order and said: "Please send better pots next time." Some of the previous lot, he added, "broke on annealing." How a crucible can break in the preliminaries of a proper annealing is as yet an unsolved problem. In this case we went to the stock and found in the rear of the pile one of the same batch as those that he complained "broke on annealing." We took it to the boiler room, where the fire was in fine shape, and without a moment's preparation, or delay, threw

the crucible on its side on the coal where the heat was a bright cherry red. The pot stayed there some twenty-five minutes with boiler doors closed until it was red hot. We withdrew it from the fire and immersed it in a bucket of cold water and let it cool till it could be touched, returned it to the fire the other side down, brought it the second time to a red heat and gave it a second cold water bath, and when it was once more cool enough to handle, it rang like a bell, and one could not see that anything had happened to it. This was from the same batch as the others that were reported "broken in annealing."

By a batch I mean that for convenient handling a given quantity of the crucible mixture is prepared at one time. This given quantity is called a "batch." As we work by many different formulas, each batch is numbered, a careful record kept of its ingredients, and further than this every individual crucible is stamped with its batch number, so that its pedigree can be ascertained at all times.

Our furnace man asked why we were testing the crucible in the manner that I have mentioned, and on being told that duplicates had "broken in annealing," said: "I guess he annealed them with a sledge." The pith of annealing is that the crucible walls should be heated and cooled off evenly, and that it receive heat enough, and no more than enough, to expel its accidental moisture. An additional word is specially suggested, if the crucible is a large one: After toasting its outside walls, set it over a black, low, slow fire, bottom side up, so that the inside walls as well as the outside can feel the good of the toasting process. Do not, for annealing purposes, set a crucible bottom side down at an angle say of 30 degrees in the hole of a hot furnace hole. We had one returned some months since that had been treated that way. The flame marks on the bottom of the pot showed this, and we, the makers, were blamed and asked to send a new one because it had scalped. We would have been placing and replacing until this day if that practice had continued.

After annealing, the next thing is to get the glaze on the crucible as soon as possible, by as rapid first firing as possible, consistent with the safety of the pot.

The mixture of the crucible contains ingredients that at a sufficiently high heat ooze out in a vitreous and glass-like paste, which after flowing down the sides of the crucible, sets, covering the crucible with a protective coat. You must also remember that the graphite in the crucible is carbon, and free oxygen will, if permitted, unite with the carbon and take it away. When this takes place, the graphite has disappeared and it looks like a clay vessel. The melter then complains to the crucible maker saying: "The melting pots are not as usual, they have no graphite in them, and look like a clay pot." Then again, take any crucible and the microscope will reveal over its surface, invisible to the eye, fine hair cracks. All this the glaze will take care of. Once the crucible has this protective glaze, the oxygen is powerless to disturb the graphite and the invisible hair cracks are sealed.

The furnace draughts and dampers should be so regulated as to produce a reducing flame instead of an oxydizing flame, the latter being, as before explained, always unfriendly to a graphite crucible. By a reducing we mean one where the dampers admit just enough air to burn the gases, and by an oxydizing flame is meant one with surplus air, which promptly goes for its affinity, and in the crucible it instantly finds its affinity in the graphite.

A third hint concerns the fit of the tongs. In a fire hot enough for brass or copper fusion, the crucible becomes soft and pliable. In lifting it to pour, if the tongs do not fit or are not made to grip the crucible at the right place, you may in the struggle to sustain the expensive charge, bend the pot too much, and it cracks.

The proper way is to grip the crucible just below the bilge so it will not need such a tight squeeze. Some melters use tongs shaped like the ace of spades, they grip better and remove the coal much more easily, thus preventing clinkers attaching to the pot.

Again, never allow any metal to cool in the crucible, but pour until the melting pot is entirely empty. In the parlance of theshop, don't leave the crucible so you will find a "button" in the bottom when it is cooled off.

In cooling, each button will have small threads or spikes of metal which will attach themselves to the soft crucible walls and become firmly fixed in them, and the walls of the pot are torn in getting them out.

After pouring your metal, don't roll the pot out of doors where it will get rained upon, or place it on a bed of wet sand, where it will absorb moisture. If you do, you put it exactly where, in its hot, soft condition, it will become spoiled either teetotally or partially. In lifting large pots by the crane, don't release the grip and let them drop four or five feet on a stone floor, rather hold the grip until within two or three inches from the ground, and then drop them if possible on a bed of old dry sand.

In filling the pot don't pack ingots or scrap too tightly, expansion and contraction go on in the heating and the cooling, and a little gumption is necessary here to prevent the pot from being strained or cracked.

In ordering your crucibles give the maker a hint, first as to your fuel, whether coal, coke, gas, or oil, then, as to the metal you melt, also if possible your average time of heat. He can then send a pot better adapted to your special work.

In the old times a crucible was made only by one formula, but now the Dixon Company make crucibles by twenty different formulas or mixtures as we call them, and produce coal fire pots, coke fire pots, oil fire pots, and gas fire pots and different crucibles for melting steel, brass, nickel, phosphor-bronze, and other metals.

A certain customer of ours noticed that he used up an invoice of pots in about half the usual time, he thought of his flux and sent us a small sample, we sent him another crucible making it by another formula, which overcame the difficulty. It was simply a case of better adaptation after we knew the nature of the flux.

For causes of failure or unreasonably short life in a crucible we may mention:

First. The wrong kind for the service, either a pot unsuited to the furnace, to the metals, or to the fuels. Every up-to-date shop is now equipped with fierce draughts, taller stacks, corrosive fluxes, so that the old time two and one-half to three hours' heat has dropped to one and one-half and one and three-quarters hours.

Don't expect the crucibles to stand this extraordinary extra strain unless you are equipped with a crucible made with a knowledge of the special situation.

Second. The life is shortened by rough handling, a great deal of which is unavoidable. The melter's job is a hard one, he works always in an atmosphere of excessive heat, his eyes are invariably in distress, he lifts heavy weights of seething molten iron, he literally earns his bread by the sweat of his brow not only, but of his whole body, his work taxes his every nerve, and every muscle. Not much wonder then that now and then the tongs squeeze a pot to a crack, or he flinches from the sometime extra care necessary.

Third. The life is shortened by corrosive fluxes. These fluxes are introduced to promote fusion and give clean slags. The crucible maker does not know what the melter will use, the melter does not always know the destructive influence of his flux on the walls of his particular melting pot.

I ask great respect for the graphite crucible, there are not many men and not many things in this world for which there are not substitutes, but for the graphite crucible there is no known substitute. It is a fragile thing, and you ask it to do and stand what nothing else in this wide world can do or can stand. .

The president having temporarily left the chair, the same was taken by Vice-President Best, of Montreal.

The Chairman: We have listened to the very able paper presented by Mr. Walker, on the use of graphite crucibles and their care. It is now in order that you should discuss it in any part.

Mr. Putnam: I have used graphite crucibles for a great many years, and my experience with them corresponds very closely with what the gentleman has said concerning them, and I cannot add anything to what he has said, my experience being only in the use of them in melting brass and iron. I regard his views as perfectly correct. I wish for my own part to thank him for what he has said, for I have received information of great value.

Mr. Metcalf: In regard to annealing crucibles I may say that I was connected with an open hearth steel plant at one time, and we annealed our stoppers. We had had a great deal of trouble with them breaking, and on several occasions we lost the steel. We instituted a practice of putting all our stoppers in the furnace and starting them at a black heat the first day. At quitting time we increased the fire. On the second morning they were brought up to bright red heat, and kept that way all the afternoon. We then brought the heat to the melting point of steel, turned the gas out, closed the drafts of the stack, and sanded the door well to prevent draft and let the stoppers set until thoroughly cooled. We found any stopper that went through that trial would not crack in casting our ingots. I got one barrel of stoppers at that time, put them in the furnace, and treated them in exactly the same manner, and expected after they went through that process that the defective ones would show up. The stoppers were of splendid size for a steel ladle, and I put them through that treatment myself, and when they came out there was not one stopper the size of a walnut, and they were of a pink color all through. I want to ask Mr. Walker whether those were really graphite stoppers.

Mr. Walker: The stopper that would behave that way was not made of graphite up to the standard.

Mr. Metcalf: That was my opinion, but the man who made the stoppers said they were made of good material. As we had paid for them he would not replace them

Mr. Williams: I was listening with great interest to the paper read by Mr. Walker on crucibles. I have had a little to do with crucibles myself. I have used crucibles made of the common clay and of the latest stage of graphite, plumbago as we know them. I have used some of the first and best crucibles made in England, the Morgan of Battersea, a graphite crucible, and found it, of course, first-class, just the same as the Dixon and others made in this country now. The annealing of the crucibles was something which I think had to be learned and watched very carefully. It was by doing so that we found we got the benefit

and the proper results from the crucibles. Often I have seen crucibles placed in furnaces that were not properly cooled, etc. There were chunks coming out of the sides of the crucibles. Very often some of the foundrymen could not understand the cause of that. They had taken their crucibles and placed them in a stove or their furnace in a bright heat, and of course they could not expect anything else but a scalped crucible. I have found it a good method in annealing crucibles when we received them to place them in a recess in the core oven, not too close to the furnace. There is generally a place there which can be utilized for that purpose. Before placing them in the furnace for melting purposes we placed them on top of the furnace after finishing taking all the heats off in the evening, and the fire was allowed to die out some. We allowed them to stay in the furnace during the night with the heat dying, and that proved to be a very good method of annealing the crucibles, without any expense necessary to generate the heat for that purpose. We never allowed the crucibles to be placed where damp could reach them, as I have found that condition very detrimental to them. I have always found that where a crucible was properly annealed in the manner I have mentioned, that I could bring on an average 35 heats from a good graphite crucible.

Mr. E. H. Putnam then read a paper on "Chilled Iron and Chilling Iron."

CHILLED IRON AND CHILLING IRON.

By E. H. PUTNAM.

At the request of the executive board of this society I have prepared this paper, and if, happily, it shall prove helpful, I shall consider that fact ample return for my endeavor. What I have to offer you is the fruit of long practice in iron founding. I cannot, of course, expect to give anything like an exhaustive exposition of the subject in the time at my disposal, but if I shall be so fortunate as to engage your attention I hope that our half hour will not have been unprofitably spent.

Chilled iron is iron that has been cast in a mold constructed, partly at least, of iron, one effect of which is to solidify the casting to a greater or less depth, so quickly as to prevent separation of the carbon from the iron. The elements in such iron are chemically combined with it (though in non-chilling iron it is impossible to hold the carbon in combination), producing an approximately uniform and close grain or texture and of white fracture, whereas, iron of the same grade or mixture cast without chilling presents a gray fracture and is comparatively coarse and rough in texture; because the carbon during the slow process of cooling has become separated from the iron and lies in flakes within the mass between the iron crystals.

Chilled iron or iron with its impurities held in combination by the mechanical means of chilling, is of much less transverse strength than the cellular gray iron, but its crushing resistance is vastly greater. Again, chilled iron, or iron whose carbon has been fastened in the combined state by chilling is much stronger than iron whose carbon is combined in the pig.

The grain of the fracture in chilled iron is very different from that in all other irons. Common white iron has a very irregular grain and much the same may be said of gray iron. But chilled iron of the highest class presents a beautiful fracture whose close lying crystals of uniform shape and dimensions, fine, and, to the

practiced eye, satisfactory, are the happy response to intelligent effort and evince man's power over the things of nature.

CRYSTALLINE TEXTURE.

I said the cellular gray iron is coarse and rough. This is because of the uneven texture of the mass, the iron portion being a sort of honeycomb framework, whose cells are filled with graphitic carbon. The iron is hard and rigid, but the graphite is soft and flows almost like water under pressure of the fingers. Therefore, the chilled iron is immeasureably the better for the purpose of crushing anything; as grain, in the manufacture of flour, or of reducing rocks for various mechanical uses, such as making rubble for roadways, or of stamping ores. The gray iron being cellular and soft, would speedily wear out, becoming rough and therefore useless in a very short time. While the chilled roll, having a uniform texture of extreme hardness, would wear very slowly, and, more important still, very evenly throughout the whole area of surface.

Another feature of the chilled roll which renders it available where mere white, hard iron is out of the question, is the fact that it is hard and non-cellular only where such qualities are desirable, while the remainder of its mass is a very fine cellular structure, conducive to the greatest possible transverse strength, yet easily susceptible of tooling, thus rendering it, we might say, perfect for the uses to which it is put.

CHILLED PLOWS.

One of the largest uses to which chilled iron lends itself most admirably is in the manufacture of chilled plows. I remember an episode of chilling which happened in my father's foundry when I was but three years old. As I stood near my father, who was at that time manufacturing chilled plows, I saw a little child fall into the water tank. I mention this impressive circumstance in order that you may see why I recall a chilled plow foundry scene of forty-five years ago. Chilled plow foundrymen of that day realized but very little indeed of the splendid achievements that

were yet to transpire in that line of industry. Any kind of iron would answer; the principal question being, is it cast on a chill? Indeed, it was almost a matter of indifference with most plow makers as to whether the chill were used or not. Still, there was nothing strange in this. The great things of this world are not each the fruit of the labor of an individual, but they are the crystalized product of the protracted efforts of many. And so, the chilled plow has attained its present state of approximate perfection only within the last twenty years. It is no part of my purpose to review the history of the evolution of the chilled plow at this time, but I mention it incidentally to the topic of chilled iron.

I have no practical knowledge of the chemistry of chilled iron, and therefore, as to this, I must trust to the dictum of those who have prosecuted their inquiries in this direction.

I find that chemists generally insist upon the imperative need of their peculiar skill in conjunction with that of the founder, and I am not at all sure but that chemical analysis could be employed in most foundries to advantage, from a money-making standpoint. But I am content to leave the advocacy of this system to such as can handle it better than I. Pardon me, however, if I state that I think the more appropriate place for the chemist is at the smelting furnace, where the iron is produced, and that all iron should be analyzed and the character guaranteed. The smelting furnace generally falls very far short of what it must yet attain to in the matter of accommodating its customers.

Chilled iron has certain physical characteristics that indicate excellence in quality, and these are the only guide of most foundrymen in the conduct of their business. It would be impossible to describe these in such a way as to convey an intelligible idea to the novice in chilled iron; yet they may, I think, be so described that he who follows the business and watches it closely, comparing results with this description, will know when he is producing good or bad iron. For it is quite possible to produce very bad results with the very best of iron.

The desideratum is a fine grained, solid, strong and very hard iron. Some irons or mixtures of irons produce a very coarse

crystal, and are therefore intolerable, because weak, if nothing else. When this occurs, simply change the proportions of the various irons in the mixture as indicated till the fine crystal and the normal strength appear.

Chilled iron sometimes, like gray iron, has small cavities which are, of course, in the last degree objectionable. You frequently see these cavities in the pig. Remelt this pig with a per cent of scrap and pour it into castings and the tendency to show cavities will be diminished. But take this pig iron and say, two other brands of pig, and mix them with a proper per cent. (say 50 per cent) of scrap and the cavities will probably disappear. It is the same old fact that iron is improved by remelting, to a limited extent.

It is desirable to chill some castings clear through, so that a fracture through any section will be entirely white, while in other castings the depth of chill should be but a fraction of the whole diameter. But we shall do well always to bear in mind that white iron or iron in which the carbon is all combined is, as to transverse resistance, weak, though the same iron poured into a sand mold and not chilled might be of the very strongest. It is, then, obvious that the tendency to chill should be no greater than the work in hand demands, in order to secure the highest possible strength.

Hardness is inherent in true chilling iron well chilled, and the normal strength results from following the above rules, provided you gauge properly the chilling tendency of the mixture.

Let me make sure of being understood about this. If the only desideratum were that the tendency to chill should be sufficient, then the making of a chill mixture would be one of the simplest of matters. But, in fact, any considerable excess of chill tendency detracts from the quality of the casting, because, while it gives nothing desirable, it diminishes the strength. This refers, of course, to deep chilling mixtures. The permissible latitude is, however, sufficient for all practical purposes. That is, a skillful ordering of the mixture will insure sufficient chill without sacrifice of strength. And, on the choice of irons for this mixture, largely depends the amount of profit, for there

are several dollars difference per ton between two first-class chilling mixtures.

THE DIFFICULTIES IN MAKING CLEAN CHILLED WORK.

Many people find it difficult to make clean chilled work. This arises partly from the fact that iron, so hot as this should be melted and cast, will cut and disturb the sand more than the less heated soft iron. For, though white iron may fuse at a lower temperature than gray iron, it certainly requires a much higher temperature to make it sufficiently fluid for casting.

Pardon me if I dwell for a moment upon this point. I cannot but think that a great many foundrymen have had very disheartening experience in the manipulation of white iron and chilled iron, just because they have heard or read somewhere or perhaps everywhere that iron high in combined carbon melts at a lower temperature than soft gray iron. In the light of my own experience, I wish that every man who asserts that hard iron fuses at a lower temperature than gray iron would at the same time explain that because of being less fluid, it must have much higher heat in order to successful casting. But does chill iron really fuse at a lower degree than soft gray iron? I see that some recent writers deny it; and I am glad of it! I hope, in the name of consistency, that the denial will be sustained; for it is a seeming paradox to say that hard iron fuses at a lower degree than gray iron, while you know that in order to cast successfully your hard iron you must use much more coke than with gray iron. But this is a question for the chemists to settle and I am content to leave it with them. Though I must give them this parting shot, that is, however much less heat it may take to melt hard iron, it certainly requires a great deal more heat before it can be cast.

Extraordinary precautions should be taken against dirt in chilled iron. As foundrymen generally know, the surface iron in the process of filling a mold does not flow, but chills and clings to the mold surfaces or walls, while the iron on the upper surface, if undisturbed, unfolds itself against the side walls, carrying with it and holding whatever of foreign substance may be present. Of course, this same process takes place in casting in gray iron.

But a chilled surface is nearly always required to be perfect, is generally turned or polished, and any imperfection would at once appear, and the casting would be worthless. Of course there are no means of skimming chilled iron that do not apply with equal force to gray iron. But as my work for many years past has been largely in chilled iron I have been compelled to give much more attention to cleanliness than would otherwise have been the case. And I think I may claim to have fought a winning fight against dirt in iron.

And in the hope of helping some one a little, I will say that if you give the dirt a good chance it will keep out of the mold by virtue of its own character. The dirt is very much lighter than iron and therefore if you provide sufficient room in the system of gates for the dirt to dodge above the inflowing current and behind some obstruction, it will invariably do so. The down-gate itself is an excellent skimmer if sufficiently large and if kept filled to a point above the surface of the runner. In rolls the pop-gate is often most desirable, as it keeps the surface of the iron constantly agitated and so prevents the dross from clinging to the mold walls, whether these be of sand or of iron. But, above all things, never stop short of success in making clean castings. And now,

WHAT IS CHILLING IRON?

It may be thought that this is a very simple question, easy to answer. But I answered the question, as I thought, some time ago in the foundry department of The Tradesman, and next thing I knew somebody said (also in print) that I didn't know what I was talking about. I don't like to be too positive of my knowledge of a thing, for I realize that I might possibly be mistaken. I have been manipulating chilled iron only for about fifteen years, and so haven't had time to learn it all. But, to give you an idea of what I don't know about it, I will say, for many years I was in the habit of melting daily in one cupola, at one heat, from three to five distinct grades or mixtures of irons; from two to four of these mixtures being chill mixtures and one of them being required to be so exact in chill tendency as to give the required

chill from mere contact with the sand—no iron chill being used for this particular mixture. One of the mixtures was for soft gray iron, and during all of this time I never knew what I thought to be a non-chilling mixture to chill, save on a few occasions. The No. 2 charcoal iron on these occasions proved to be of that anomalous character wherein the fracture does not tell the truth. Then, during another period of years, I made three mixtures to a heat daily, using many different brands of both charcoal and coke iron, and yet I never learned from experience that anything but charcoal iron was a good chilling iron. Of course, I am well aware that coke iron may be used very largely in the chilling mixture, but I believe that if you produce good results the chilling tendency will be given by something else than coke iron. My experience in handling chilled iron has been had in three different factories, and in one of these, at least, I was enabled to experiment to my heart's content. I made very radical variations in per cent of charcoal and coke irons and, in fact, I produced chilled castings from coke iron alone. After this, it may sound paradoxical for me to say that I do not regard coke iron as a chilling iron, and yet that is just what I say. To produce chill in coke iron the pig used must be so high in combined carbon as to render the casting product extremely weak.

The tendency to chill is, in coke iron, generally very slight. On the other hand, the chilling tendency in the various numbers of charcoal iron of approved brands is great and approximately constant. So that the operator can make a mixture of charcoal and coke irons that will produce any desired result.

Mr. Keep in his "Cast Iron Notes" in The Foundry, says: (November, '96, p. 124, second column) "Lately it has been found that non-chilling coke iron can be used for car wheels by using portions of malleable scrap, which impart a chill. The chill in such cases is largely obtained, however, by the use of old car wheels."

Again in The Foundry, p. 93, November, '95, Mr. Keep says: "Some charcoal pig iron will not produce a chill, and some coke iron will. It is not a question of chemical analysis. Some irons

that are chilling will show the same analysis as others that are not chilling." If the latter is true the former must be true also. I must say, however, that in about fifteen years of constant practice in the manipulation of chilled iron mixtures, though I have sometimes found a charcoal iron that disappointed me in some measure in not chilling so deeply as I had expected, and though an occasional car load of coke iron has shown an abnormal tendency to chill, yet the line of demarkation between the two has as a rule demonstrated the chilling tendency of charcoal iron and quite as distinctly the non-chilling quality of coke iron.

Of course, charcoal iron is far more costly than coke iron. Fortunately, however, the chilling tendency of some charcoal iron is so excessive that a large per cent. of non-chilling iron may be used in the mixture, which will still have sufficient depth of chill. Charcoal iron alone was formerly used in chilling mixtures. But in recent years coke irons have been much employed as the factor for reducing chill tendency. In my opinion, nothing has been lost by this change, for you still depend upon the charcoal factor for the chilling quality.

I do not know of any reason why coke iron should not possess the same chill tendency as charcoal iron. I only know that in general it does not. It would not be a matter of surprise, however, if chemistry should in the near future solve this problem for us. It is certain that if any man could to-day produce a chilling coke without extra cost the equal of the charcoal product he would not have to keep the secret of his process long to make him the richest man in the world, for the difference between $7 per ton and $14 per ton leaves room for a very comfortable profit.

With regard to chemical analysis and physical test, I do not doubt the value of either. But the great majority of our founders cannot or at least think they cannot, afford chemistry. Whether they are right or wrong, the fact remains that the adoption of chemical analysis will be a slow process. I do not know whether anybody else in the world makes a chilling test of the molten iron before casting it. But I always do; and by this means I am enabled to make an approximately uniform grade of chilled cast-

ings throughout the heat and throughout the year. My cupola ladle is large enough to hold a whole charge of iron and I melt it so hot that after tapping out it may stand for several minutes and still be amply hot and fluid enough for casting perfectly. We tap into this ladle and when about three-quarters full a test casting is made upon a chill. This casting, perhaps three-quarters of an inch deep by one inch wide by four inches long, will solidify in less than a minute. It is then immediately plunged into a bucket of cold water, and as soon as it turns black it is broken and the depth of chill appears. If just right the iron is at once poured into the molds; if a little too hard or too soft, more iron is tapped into the ladle and another test taken. Thus we know that every casting we make is just what we wish it to be.

The molding for these tests is done thus: The flask consists simply of a cope part, perhaps three and a half by six and a half inches by two inches deep. The pattern, three-quarters of an inch deep by one inch wide by four inches long, is cast solidly on a cast iron plate, whose length and breadth corresponds with that of the flask. The down-gate, or "pop" gate, of conical shape, is also solidly cast on top of one end of pattern. The flask is three-quarters of an inch thick, so as to make it heavy, thus obviating the need of weights or clamps in casting. Now, a pile of sand is riddled and the flask is set upon the pattern plate, a double handful of sand is thrown in with force, a couple of strokes of the hand ram, strike and expose the top end of the pop gate. The draft of the latter and of the pattern are so sharp that the cope is quickly lifted therefrom, and set down in position upon a long, planed and oiled cast iron plate or chill. Enough molds can be made and placed upon this chill for the day's use in a few minutes. The tests, after examination, should be placed in regular order upon a shelf, so that next day before making up the mixture for the charges those tests may be closely scrutinized and any variations needed may be made in the mixture. Of course, we make test bars also, every day, and their transverse strength, deflection and especially the character of the crystallization, furnish a constant and efficient guide, which, together with the known excellence of the irons used, leave little to be desired.

The President: You have heard the excellent paper of Mr. Putnam, and it is before you for discussion.

Mr. Ferguson: I have been very much interested in the paper read by Mr. Putnam, as I have been prominently connected with chilled work, ranging from a quarter inch chill to 4 and 5 inches in thickness for the past fifteen years, both with and without the aid of chemistry, and also with more or less success. A question has in that time originated in my mind, and I have asked it of others, but they never have a solution. It is what makes iron chill. It is a simple question apparently, but I have never had a solution, never could satisfy myself. One man tells me it is phenomenal. Another it is combined carbon. But as a result of careful analysis I am satisfied that while combined carbon cuts quite a figure in the chilling it is not responsible for the action of chilling entirely. My own solution now is that all the elements cut a figure in the producing of the chill. There are hard chills, and soft chills, as there is hard and soft iron in the gray irons. I will cite an example to carry out what I say in regard to the chemical analysis, in an instance where I had 1½-inch chill to produce on castings, the analysis being 1.53 of combined carbon. A similar piece of iron of the same depth of chill and to all appearances identical to the other contained combined carbon only .60. It must be the difference in the quality of that chill produced in some way a change either in the wearing quality, strength or otherwise. I believe there is opportunity for investigation and lots of discussion on this subject of chilled iron.

Mr. West: There is no question but that chilled iron involves more complications and requires chemistry more than any other grade of iron which we have to make in our foundries. A chilled roll manufacturer in every branch will find himself running against obstacles which very often prove exceedingly hard to overcome. Mr. Putnam's paper called up one question which has to be settled, and that is, does hard metal melt sooner than soft? I have taken the position that hard iron melts quicker. Mr. Knight in the last number of The Foundry raised a question in the opposite direction. There is certainly room there for dis-

cussion, and probably for some great investigations in order to find accurately what is true. We have many authorities asserting that hard iron will melt quicker than soft. In my own experience I have noticed such to be the case, and in fact have been led always, when I have to bring three or four mixtures out of the cupola, to place the hard iron first. It seems to me there is a chance for investigation, and chemistry may help us out. To what metalloid is the hard iron due? We can create hard iron by having no silicon, and we can make it by having high sulphur. As a general thing hard iron is created by the higher sulphur, and I notice Mr. Knight stated that he placed a piece of white iron and a piece of soft iron on the cupola plate on the charging door, and the soft iron melted first. It occurred to me in studying, I do not know whether I am right, that he simply laid pigs on the charging door where they would get the flame. That is the only way I have of understanding his illustration. The heat must have been very strong to have come up there and melted those samples. I am inclined to think an investigation on the metalloids which prevail in hard iron might go a long way to solve that problem. I am inclined to think that where we find higher sulphur we shall find the iron to melt the easier. But if it is caused by low silicon it will be the reverse, as we find in blast furnace practice it takes heat to give the iron silicon, which is the element which goes to make our soft iron. The greater the amount of silicon the softer the iron. It is an important question which has been recently brought up, and I for one would like to see it extended. The next important question in my estimation of Mr. Putnam's paper is the question of the non-chilling and chilling iron. As to finding coke to be generally classed under the head of a non-chilling iron, if I understand Mr. Putnam right, he did not employ chemistry. As a general thing we find that coke irons always range higher in silicon, and the greater percentage of silicon we have in the iron the more non-chilling it will be. And if we do not employ a chemist to ascertain just what is in the iron, we are never going to be able to answer that question intelligently. If we have exactly the same analysis or the same percentage of the different metalloids

in the coke iron that we have in the charcoal iron, I cannot conceive why one would not chill to as great a degree as the other. Of course we have physical conditions which come in to affect these elements, but if it is not true that the same analysis in these two metals would not be the same in the qualities it goes to a large extent to prove that chemistry in using it is of no value.

Mr. Ferguson: I would like to ask if any of the members here are familiar with any tests for determining the relative hardness of chills. We have tried the grinding test, and the scratching test, and also worked somewhat on specific gravity test. I should like to hear from Mr. West further to know what makes iron chill.

Mr. Sadlier: Some years ago I was in Braddocks, and had a conversation with the manager of the Carnegie furnace there. He claimed that in making the determination of the furnace, to take a direct process, he put it in a converter and took the steel there. The determination would not hold good when it was conveyed from the furnace to the converter, which was a distance of about one and one-half miles. He claimed their chemist had given the matter considerable attention to find the cause why it made such a rapid change when going that distance. I asked him if it was not possible that the same conditions prevailed there that did in the puddling furnace, where if the puddling process is nothing but boiling the iron and boiling the graphite out of the iron, the iron itself remaining melted for a considerable time will purify itself and reduce to nearly the line of wrought iron. I imagine that the iron in the cupola from the time it begins to melt takes up a certain amount of the gases from the coke which is in the iron, and if the metal which has stood in front of the cupola was to be suddenly chilled just as when against an iron chill, the whole mass would assume the same appearance as in the chill. I think when I use a melt that is re-poured, the gas escapes from that for days. That has all been confined at one time in that metal. It is that gas, taken up by the iron in the cupola which, to my mind, causes the chill. It causes a combination in there that the chemist does not reach in that way, because it is formed by the metal itself.

Mr. West: I cannot conceive of the action as stated by Mr. Sadlier, as being the one to cause iron to chill. We are told by chemists and metallurgists that the carbon in liquid iron is all in a state of combination or combined carbon. I believe such to be correct. I believe if we follow out that line it will simply bring us back to the conclusion that chilling is no more or less than promoting the formation of vapor. Mr. Ferguson here, when on the floor last, spoke of the difference of the different degrees of hardness. I think the consideration of that point would still carry us to think it was correct that it was no more than the carbon. You can take iron in a ladle, the softest kind of iron made, and if you will pour some out of the ladle in a pail of water, you will have chilled iron. The line of thought in that direction would be largely sustained or proved by an analysis of chilled iron.

Mr. Metcalf: In regard to what causes the chill in cast iron, my theory is that when the iron is melted, all the elements in the bath are in the state of chemical combination. If the whole mass could be instantly chilled, we should get white iron. It would make no difference what the percentage of silicon was as long as we had the carbon there. There is a difference—not only a chemical difference between the chilled part of castings and the gray iron back of it, but when the iron comes in contact with the chill, the carbon is held in solution, or chemical combination, and cannot escape, and the chill is actually part of the iron. The part that does not come in contact with the chill is in a state of mechanical mixture, not a chemical combination. Break the soft pig iron, and you can shake the carbon out of it. There are two entirely different conditions in the different parts of it. Take drillings out of a pig to make a chemical analysis, and analyze the coarser part of your turnings, and you will get a lower percentage of carbon than in the fine dust, showing that the carbon and other elements are simply of a mechanical mixture. As to whether hard iron or soft iron melts at the highest temperature, my experience has been this: We all know wrought iron requires a higher temperature to melt than either cast iron or steel.

I have seen in a furnace a mixture composed of pig iron, soft scrap, and hard white iron, and a piece of steel.. The steel weighed when it went into the furnace about 3,000 pounds. The pieces of soft iron and the pieces of white iron were much larger and would require a longer time to melt. The pig iron was melted first, the chunk of soft scrap next, the white iron next, and the steel we took out the following morning. The steel is still in our yard, and anyone can have it. I believe the difference in hardness gives rise to misunderstanding in regard to it. There are different grades of cast iron and steel, which are due to the lower carbon. In soft cast iron the carbon is hard. In the harder cast iron it goes down until it approaches a steel stage, and we all know steel requires a higher heat than any grade of cast iron. That is my reason for believing that a hard iron requires a higher temperature than a soft iron.

Mr. Lanigan: I would ask what changes the nature of the iron in a slow process or in quick melting. Why is the chilled part on the top as it lies down horizontally?

Mr. Metcalf: The reason the chilled part is on the top of the iron is that the air is a better conductor of heat than sand. Sand retains the heat and cools so slowly that the carbon separates and becomes graphitic. The carbon has no chance to separate from the iron chilled on the top.

Mr. West: The gentleman just seated gave the reason for the degrees of hard iron as due to a greater or less of percentage of carbon. I would differ from him. It is not the percentage of carbon, but simply whether we separate the carbon, or how much we separate it from the mechanical mixture which he describes. That is proven by the little experiment of pouring into water and sand. It is a question of time of cooling largely whether we take that carbon out of the chemical combination.

Mr. Metcalf: Mr. West did not understand me. My idea of hard iron is not its chilling property. Take chilling iron and add silicon and keep your carbon constant, and you can kill the chill. Take white iron and cast it in a roll and you will get

it all right. Take chilling iron and cast any form of roll, and you get three-quarters to one inch chill. Take a casting in sand, and there is not the same difference when cast against iron. Hard iron is not chilling iron—the two are entirely separate and distinct. That was my line of thought when I said that hard iron required a higher temperature than soft iron.

Mr. Frank: Mr. West stated a test of immersing iron in combination in water. The shots resulting therefrom would be chilled. Did Mr. West ever try to take in 2½ per cent silicon with say 3.80 carbon, and see if the shot chilled? While those shots would be very close in texture, they would have no tendency to chill. If, on the other hand, he took 1 per cent of silicon and 3.20 carbon, the probabilities are he would have chilled balls. That same mixture cast in sand would not chill. The statement that any iron suddenly cooled would be chilled, is erroneous. It would close the crystal, but would not hold combination of carbon. Now, as to rapid melting of hard irons, there is *hard* iron and *hard* iron. Hard iron may be produced by high silicon, and it may be produced by high sulphur. It may be produced by very low carbon. The three irons will melt at entirely different temperatures. You will get the high silicon iron to melt rapidly, and the high sulphur iron to melt rapidly, while the low carbon will melt slowly. As an illustration of the rapid melting of iron, if you ever have a tap-hole that gives much trouble, you can open it readily by taking flour of sulphur and holding it against that portion. The iron that runs out will be very white, and white in the presence of a large percentage of sulphur. High sulphur iron may be hard, but will melt in lower temperature. High sulphur iron will melt at a lower temperature than red. That is where temperature comes in.

Mr. West: Mr. Frank's remarks in reference to the melting point of hard iron are in keeping with the suggestions I first made in that line. It was one of the factors which have led to the general acceptance of a belief in hard iron melting quicker than soft, based entirely on the fact that as a general thing hard irons are produced with higher sulphur. In reference to the quality

of chilling by the sudden cooling in water, there is something in what Mr. Frank has said in that line. We do, of course, make a decided difference in the grade of the two irons—that which has appeared to cool slowly, and that which is cooled quickly by immersion in water.

Mr. Metcalf: In reference to Mr. Frank's remarks, I would say, if you put flour of sulphur on the outside of the tap-hole when the iron is red, and you melt that iron out, there would seem to be an impression formed that the cast iron would be melted readily—that it would get hot in a few minutes. That is not my idea at all. It is simply the affinity of sulphur for iron, which is very great, and if you take the iron red hot and put sulphur with it, it is no more than a chemical mixture and subject to a very intense heat. If you put your sulphur, as suggested, in the red hot iron, an intense heat is generated, which, in my mind, melts the iron out of the tap-hole—it is not that any iron melts with dark red heat. It is simply the combination between the sulphur and the iron.

Mr. Best: I have had no experience in the use of chilled iron, neither would I like to be very close when the cast was made in water. Unfortunately, in casting the gray iron, some molders like to use water on the mold, and it is my experience that irons cast that way with water on the mold make hard castings to machine. We have had to throw away tons of iron on account of its being chilled that way. It has been stated here that gray irons are not chilling irons; but the fact remains, that we get a very strong chill sometimes on iron cast in a mold excessively wet.

The President: To add a mite to this question, I would say that we must not lose sight of the physical laws that cause chilling of irons. The chilling is what we might term a relative condition. All irons have a tendency to chill, and in some cases the chilling is apparent to the eye. In others, the hard chill Mr. Best speaks of is formed. It is due to the capilliary force and the tendency of the molecules to pinge towards the cooling surfaces and follow the cooling waves. The rapidity with which

the heat is dissipated gives you a ratio of hardness. Some irons have these peculiar qualities to such an extent that the molecules become more dense and combine the carbon more readily by the rapid dissipation of heat, while others, notwithstanding the chilling surface, will not have the tendency to so rapidly enclose chemically the carbon. You know the amount of chill is dependent upon the chilling surface, because, if we cast iron against a chill half an inch thick we get a certain depth; if against a chill one inch thick, we get an increased chill. Therefore the rapidity of heat gives the relative amount of chill or hardness. The chill is in a sense an intensified hardness. Now, metallurgists have not yet been able to determine just what the physical qualities are that cause greater or less chilling. In recent years we have discovered that there are three or four grades of carbon. That fact possibly covers the secret. A casting from steel from a certain purpose might be made from a batch of material which would turn out to be all right, and yet a casting made from the same batch, but melted another time, would probably give another quality. We might conclude that the quality of heat applied will change the characteristics of these different grades of carbon. There is considerable experiment being made in Germany on the subject, and it has been pointed out that the following out by chemistry of these peculiar varying conditions of carbon is most important. To go back again in studying the matter of chilling, we must not lose sight of the laws of physics that apply to the dissipation of heat. That, in my mind, is the key to the situation.

Mr. Northrup: I have a deep interest in the matter of chill, and would like to ask a question. There seems to be no difference of opinion here as to the fact that the holding of the mass in its chemical constituency enables you to chill the iron. If it is a fact that the carbon is high and the silicon also, does it not increase the porosity of the iron, enabling the carbon in the high silicon iron to free itself more rapidly than when the silicon was low?

Mr. Metcalf: My idea in regard to chilling, in contradiction of the statement by the president, is that it is not a physical prop-

erty, but entirely a chemical property, and that unless you have carbon in chemical combination with the iron, you cannot produce a chill; and by having your silicon high you retain the carbon in the chemical state, and you can produce a chill on the surface, and your high silicon iron cools more slowly and keeps your carbon in that state, so that when the whole mass is cold your carbon separates slowly.

The President: I must say you misunderstood me; it was my intention to emphasize that it was a chemical property, but dependent on physics. The dissipation of heat is of the greatest importance in investigating the question.

Mr. Metcalf: I agree with you on that point. If you take a chill half-inch thick and make a casting you get say quarter inch of chill. If you take six inches thick with the same iron and same casting you will get a difference in the depth of chill. I understood you to mean that there was a mechanical or physical property in the iron itself. There is no doubt the chilling propensity of the iron is dependent on the rapidity on which it cools. If you have a chill of greater or less thickness, the greater will be the carrying capacity for the heat.

Mr. Lanigan: Suppose the last gentleman who spoke and myself go working in a foundry side by side, and he made a pulley, and I made one also. Suppose we pour both out of the same ladle, and one turns out hard, so it could not be touched at all, and the other was all right, whose fault would that be?

Mr. Metcalf: I would suggest that if two molds were made in the same identical way, same amount of moisture in sand, both cored alike, poured at the same temperature, and out of the same ladle, and then made uneven castings, that Mr. Lanigan did not mix his iron.

Mr. Lanigan: That is not answering my question. I said suppose we worked side by side, identically, and poured from the same ladle of iron.

Mr. Metcalf: That is where a mistake is made in making chilled iron. You can melt your iron in a furnace and say you

will watch that furnace closely, and when it is ready for your molds that you will pour. You may get the chill on the casting just as you want it, and in another casting no chill at all. If you leave that iron in the furnace longer, and get it hotter than you want for the casting and mix it up thoroughly, and allow it to cool, you get as nearly a homogeneous mass of metal and nearly uniform as can be made, provided the outside physical conditions are the same.

Mr. Best: I think, in regard to Mr. Lanigan, that if he and I were working in a foundry and we put two patterns in the same sand, and obtained metal from the same heat, Mr. Lanigan's pulley would come out all right, but mine would not. In other words, I would use so much water on my mold that the casting would not be fit to machine, but Mr. Lanigan's would be made in a drier sand and consequently would be more easily worked.

Mr. Lanigan: I know all about these little things, but wanted to see what the scientific fellows had to say in regard to making iron hard. Lots of the scientific fellows know how and also the unscientific. Take the molder accustomed on heavy work day in and day out. It might happen that the foreman would give him a light pulley to make. He might give him the best iron, but it might not be worth anything to the machine shop; his sand is wet and he rams his mold much harder and increases the moisture against his pattern. It generally happens, too, that the man is accustomed to cool his iron at a good deal lower temperature than is the case in the foundry accustomed to light work. Any practical foundryman will tell you that, and he will not go to the chemist to find it out either.

The President: I would like to ask Mr. Metcalf a question. For chilling iron we have certain mixtures, say, made of ores from a certain locality, and they analyze for certain constituents. We have iron from ores found in localities far away, and they analyze similar to the first, yet there is a vast difference in the result from chilling. Now is it not reasonable to assume that there is a physical structure of the iron that increases the tendency to chill in one more than the other?

Mr. Metcalf: I would say in reply, that you take any iron with certain elements in it, and take an iron from a different locality with the same proportion of the varied elements, and they may have an entirely different appearance in the pig. That is due altogether to the temperature at which the iron was cast at the furnace, and if you take those two pigs, analyze them exactly alike, and melt them under exactly the same conditions, you will get the same result in regard to chill. Some time ago Mr. Frank and Mr. Kneeland were both away, I took it upon myself to make chilled iron on anything I could find about the place. I took old hoops off barrels, some old core rods, and a certain percentage of high silicon pig iron, and a little bag filled with charcoal, and put all in a crucible, but our furnace would not melt well enough, and I did not get an iron with a chill on it. The one cast against a chill was close on the chill side, and the balance of the pig was open. A cast in the sand was gray iron all through. I contend that if you put the elements in the iron the two mixtures made in exactly the same temperature and cast in the same thickness you will get the same depth of chill.

The President: In other words, no difference exists in the physical structure of iron, would that be the opinion?

Mr. Metcalf: As I said before, my idea is that there is an entirely different construction in the pig.

President: I did not mean that. To make myself more plain, if we could remove all the constituents and leave the mere iron we should get a form in a cube like the cells of a bone. In different irons these cells are of different size and different forms, are they not?

Mr. Metcalf: I believe iron is iron, and all the other elements have their functions to perform. Take wrought iron that is practically pure. I do not know whether there has been any made chemically pure, but practically pure, and you will find it always much the same. It has the long fibre, and in regard to density and specific gravity it will be all the same. The wrought iron we use has been hammered or rolled, and in the hammering of it a difference is made. There is where the difference comes in the iron.

It is my belief that in cast iron, where the elements are constant, the physical structure is the same. I believe that very high carbon pig, especially on the surface of it, to a certain extent, has a tendency to chill. It is perhaps very nearly a chemical combination, but in the center the carbon is separated. Take a high carbon pig and pick out the carbon. The iron will only carry a certain extent of carbon.

Mr. Lanigan: I will ask another question. I melt a ton of iron, and it takes me 15 minutes, while another fellow takes an hour to do it in. What effect does that have ?

Mr. Metcalf: I say it makes all the difference in the world. When we built our furnaces we had a high stack, and they melted too slow. We came to that conclusion and accustomed ourselves in the meantime to get a certain test out of the iron. We reduced our melting on small heats to half an hour, and on large heats to two hours. We had to change our entire method of making our mixtures. When melting with slow fire you are burning your carbon up, and the result is, when you get your iron out of the furnace, you approach a steel nature and get hard iron. Where you melt slow the carbon comes in direct contact with the flame and burns out in the melting. The carbon is retained in chemical combination and does not burn out.

Mr. Lanigan: I want to state that the gentleman has demonstrated my experience on iron first rate. I came to the conclusion many years ago that the quicker you melt an iron the better it is. Does it not make some difference whether a man holds 1,500 or 2,000 pounds of iron in his cupola, or whether he keeps drawing it off when it melts. I think myself it is better to hold it in the furnace.

Mr. Metcalf: I do not quite understand the purpose for which you hold it in the furnace.

Mr. Lanigan: For the matter of mixing and drawing off in small lots instead of large lots. When you want to know in regard to the difference noted in two castings, it would depend altogether on when the iron was mixed. For instance, you have

some of your work ready to pour, and want to get uniform castings, and to know whether you are ready to tap part of that, and then go and tap a part again. Or whether you will let the whole thing wait until you are ready to pour all the castings. I think it is better to let the iron stay in the furnace, for if you want to get uniform castings I contend that the last casting you get will be too hard for machinery purposes, and perhaps chilled.

Mr. Metcalf: You get a larger mass when you leave the iron in the cupola, and consequently more homogeneous mixtures. A cupola man would have to be very careful in the charging or you would get all scrap in one, and all pig in the other.

The time for adjournment having arrived, the session adjourned until 2 p. m.

WEDNESDAY AFTERNOON SESSION.

The Convention was called to order promptly by President Schumann, who introduced Mr. W. H. Pfahler, of the Abram Cox Stove Company, Philadelphia.

Mr. Pfahler: I am sorry to take up a moment of the time of this meeting. The one thought which has impressed me more than anything else during the deliberation of this body has been the great attention with which every one has listened to the gentlemen who have addressed you. The subjects which have been brought forward have been interesting to all of us. This afternoon we have met to consider a subject probably of more vital importance than any one of the subjects which have gone before. How to melt iron is a problem which every one will work out for themselves either successfully or unsuccessfully, low cost or high cost, and while I was not here at the time foundry matters were discussed, I want to say that we have a little foundry in Pennsylvania melting 14 tons of iron a day for stove plate, and melting at a ratio of 8½ to 1. But what I want to say now is that the question to be presented to you this afternoon is of more vital importance than any before this body. I say that it is a question which has been brought to us every day in every avenue of life. It is a question of less hours of labor. If I know what I say, I

believe I am safe in saying that the reduction in the hours of labor in the past 50 years of this country has marked an era in the improvement of the results of labor. I believe that to-day the men who are working 10 hours a day are doing more for themselves, accomplishing more for their families, are better citizens, and are doing more for the country at large than the men of 50 years ago working 12 and 14 hours to accomplish less. It is with unspoken pleasure that I feel we can have this question discussed from a standpoint that we did not meet to reach. We can argue from our own standpoint, we may reason the dollars and cents, but there is a broader question. There is an appeal all over the land from the workingmen for less hours work. I have not met a manufacturer in the past two years who does not approve of that proposition on its broad base, and I have no doubt that the citizens of Detroit will remember a paper presented by one of their old citizens, Mr. Barbour, on the subject. I had the pleasure of introducing to you during a session of this convention Mr. Henry Cribben, President of the Stove Founders' Association, and it is my pleasure this afternoon to introduce a gentleman who I believe to-day stands the peer of any man in this country as the leader of a labor organization, a man whose wide judgment, whose untiring nerve, whose executive ability, has shown itself in every avenue he has undertaken, and I cannot say any more than I have said in introducing Mr. Martin Fox, President of the Molders' Union, who is to address you upon the subject of shorter hours.

Mr. Fox: Mr. Chairman and Gentlemen—Being nothing but a common molder, and not having had the opportunities that many other men have had, I am not a man who can get up and make a fluent speech. I have prepared therefore a paper on the question, as has been announced, of shorter hours. I will try to lay the matter before you in such a way that I believe any one, no matter what position he might take on the question, will feel that he can give the points brought out some consideration.

WHY WE SHOULD HAVE SHORTER HOURS.

By MARTIN FOX.

In rising to address you upon this occasion, I cannot refrain from expressing my congratulations upon the success that has attended the efforts of some of your leading spirits in having thus brought together such a representative gathering of the foundry interests of this country to discuss questions of common and general interest, not from a restricted local or sectional standpoint, but from the broader and more comprehensive one of a national association. It must convey to your minds, as it does to mine, another illustration of the effectiveness and utility of organization among those whose interests are so nearly identical. These meetings and the discussions which follow will, I feel assured, be productive of much good to the foundry interests. And when I say foundry interests, I do not wish to be understood as referring simply to the interests of employing foundrymen, but as well to the interests of those who occupy an equally important position in the industry, namely, the iron molders, whose organization I have the honor on this occasion to represent.

It was with pleasure I remarked in looking over your official programme that you were already actively engaged in considering how best to promote the mechanical ability of the molders of the future. In that effort you have my heartiest sympathy. I also observed that a similar committee was engaged in devising means whereby labor troubles might be avoided. In that also you have my heartiest sympathy and the sympathy of those whom I represent. The strike is but a relic of those barbaric times when the principle of "might is right" was applied to questions deserving of measurement by a higher and nobler standard.

My presence with you on this occasion, however, is not for the purpose of intruding my opinion or advice on these matters, but to bring to your notice a reform whose introduction is year after year becoming more imperative both in the interests of economy and humanity. The establishment of a shorter work-

day, preferably an eight-hour work-day—for that is my theme—has occupied a prominent position as a reform for more than a generation. In its earlier history, however, it did not command that general attention nor occupy that foremost place in the industrial world that it does to-day. In these early days, science and invention—the progeny of man's boundless genius, had not yet opened up to us those magnificent possibilities that have developed so rapidly before our astonished gaze during the last quarter of a century. To be sure there were, in those times, periods of business depression; there were times of suffering and loss, but the struggle for existence had not yet acquired that desperate intensity that has become such a striking feature of these later years. This, to some extent, may be taken as explaining the slow progress that has been made towards the realization of a general eight hour work-day. The cruel experience of the past few years, however, has given the movement an impetus that nothing else could have done. Employers and employed are alike casting their eyes about to discover the cause of a condition of trade that carries with it loss and ruin to all interests concerned. Idle labor disconsolately walks the streets, capital lies idle in our bank vaults, and expensive plants rust and decay through lack of demand for their product. From all sides arise anxious inquiries as to the cause of this state of our industries, and not the least of these inquiries comes from the working man to whom idleness means loss of comfort, loss of home, and sometimes even loss of life. I assert boldly, and I have no doubt that you will agree with me, that this condition is a stain on the fair supremacy of American genius and civilization. It leads us to think that we have spent too much time as a people in devising money-making and labor-saving methods, and too little in the perfection and elevation of our American manhood.

The argument is not a new one to any of you that the demand for goods depends entirely upon the purchasing power of those who consume them. It follows, therefore, that if that purchasing power be seriously curtailed, or what is practically the same thing if the number of purchasers be materially lessened, the

demand will be affected adversely in like proportion. If, on the other hand, the purchasing power be augmented by inverse reasoning we would experience an enlarged demand and a more healthy and more progressive condition of industrial interests. To promote and accelerate the growth of this demand may be said to constitute the chief argument, from a business standpoint, in favor of an eight-hour work-day.

It can not be disputed that all businesses would be benefited by a decrease in the number of idle workers. Put more men to work and more wheels must revolve, and as a corollary to this proposition comes the assertion that five men working eight hours each per day will create a greater demand for the products of industry, than four men working ten hours, and the fifth depending on chance or charity. It would seem, therefore, to be the part of good business policy to lend assistance to any movement having such an end in view.

In asking this Association to co-operate with the Iron Molders' Union in its efforts to establish an eight-hour work-day in the foundries, I do not appeal to you on mere sentimental grounds or as an enthusiast who sees in the eight-hour work-day the panacea for all the ills from which business men and working men alike suffer; but rather on the ground of good business policy, on the ground of business necessity. Many of you will recall the strong arguments advanced in favor of an eight-hour work-day by Mr. R. A. Hadfield, of Sheffield, England, in the course of an address delivered before the Philadelphia Foundrymen's Association. By practical test he claimed to have proven it both the most profitable and most productive system. If this be true as applied to British iron industries, why should it not prove even so in America?

We sometimes hear the argument advanced that plants have been built and equipped in conformity with the requirements of a ten-hour system. Well and good. But where is the business man among you who would hesitate to put in new appliances or introduce more economical methods simply because his plant was originally intended for an inferior system? These same ar-

guments were advanced by the manufacturers of a former generation in answer to the demand for a reduction of the hours to ten, and cannot, at this late day, be seriously entertained.

If, however, the necessities of trade demanded that all plants be run at their full capacity every available working day in the year, there would be some reason to pause before so materially deranging the economy of business as would be involved by a twenty per cent reduction of the working hours. But the actual facts are so far removed from such a premise, indeed, the opposite is so generally true, that the mere prospect of creating a healthier demand should operate in your minds in favor of the reduction in the hours of labor that we advocate. There may be individual cases, it is true, when in good times a plant is run at its full capacity all the year through, but I am greatly mistaken if you will not agree with me that such a case is the exception rather than the rule, so that we are justified in assuming that the foundries of this country in the aggregate could under normal conditions turn out an equal or even greater quantity of work in the year under the eight-hour system, by reason of the increased continuity of employment, without any material extension or enlargement of their present plants. But even if the introduction of this system, as some contend, would necessitate the purchase of more real estate and the erection of additional molding space to accommodate the increased staff, answer me if even that would not be infinitely preferable to the desultory and unprofitable style of operation, and if the capital thus invested would not be more than made up by an enlarged and healthier demand? Dodge the question as we may, the principle remains that the interests of capital and labor are best conserved when the wages of the mass of the people are highest and most widely distributed.

I have dwelt hitherto on the favorable influence of the shorter work-day upon business interests, but there is another of equal importance to be considered, and that is the moral influence on the workman himself. There was a time when employers contended that an increase of leisure would simply give increased opportunity for drunkenness and dissipation. Actual experience

has proven that this is not the case. Give men "leisure to live, leisure to love, and leisure to taste our freedom" and you make better men of them. You lift them upward in the social scale and instil in them increased desire and increased strength to raise themselves out of the degradation into which adverse fortune has sometimes driven them. The leisure of industry cannot be compared, in its effects, to the leisure of involuntary idleness. The one elevates, cultivates new tastes, implants new ambitions, broadens the mind and makes a better citizen; while the other degrades, defiles and imbrutes.

As year follows year, the effectiveness and productivity of labor is ever being increased. It is being increased out of all proportion to the increase and demand contingent upon a cheapening of production, and as the hours of labor have not been reduced in like ratio, it follows that there are constant and alarming additions being continually made to the army of the unemployed. Is it not the height of folly for an enlightened people to continue in this suicidal course? Can we go on forever disregarding the groans of suffering coming from those whom man's genius is condemning to a life of misery and want? Can we wonder that these cries of despair come dangerously near to becoming, at times, the angry shouts of anarchy and revolution? Again I say it is the part of wisdom to lend an attentive ear to the pleadings of those of our people who complain that society, despite their willingness to labor, refuses them an opportunity and ignores their necessity. The working men of this country are listening and desire as a first step to share with these their opportunity. Are you, members of this National Association of Foundrymen, ready to assist in giving effect to this desire?

I do not forget, however, that it is much easier to formulate a desire or demonstrate the necessity of a reform than to put it into practical operation. I do not forget, either, that I am addressing an audience of experienced business men who are perhaps more keenly alive to the difficulties to be overcome than I can possibly be and who, while sympathizing sincerely with us in our efforts to share with our unfortunate fellow workmen our opportunities to

earn a living, and realizing the general good that would arise from such a course, nevertheless hesitate to give their sympathies practical effect. I repeat I do not forget these facts. But how are we to overcome difficulties if we do not boldly seek to find them? The molders' organization is alive to the fact that a change of the character advocated is one of those which demands that consideration be shown to the interests of the employers involved; and as if in sympathy with your own desire to formulate a plan whereby labor troubles may be avoided, I appear before you chiefly to secure from you an expression of opinion upon its establishment in the near future, and to secure your co-operation with a view to advising together how best to surmount the difficulties in the way. If we can come together in cases of this kind and discuss them free from prejudice and with a single eye to the welfare of all interests concerned, we will have taken a most advanced step towards avoiding the friction arising from conflicting purposes.

But returning to the more immediate subject (I desire to deal briefly with one or two of the practical objections that might be raised to the eight-hour work-day), I have already given my opinion on the capacity of the foundry plants in the aggregate and will not again dwell upon that phase of the subject. There arises the question—shall this reduction in the hours of labor be with or without a corresponding reduction of wages? This is a serious question, too. On the one hand it would effect a very material reduction of incomes already none too adequate for the demands upon them; and on the other it would materially increase the cost to the consumer. If it were possible to inaugurate the eight-hour system, simultaneously, in all the foundries of the country, I would unhesitatingly advocate the reduction of the hours without a corresponding reduction of wages. But that we know to be impossible and if, in the face of that knowledge, workmen still seek to exact that condition from employers who are willing to test the eight-hour system, it seems to me that it would be placing them at a very serious disadvantage with their competitors, unless, indeed, their men produced as much in eight

hours as they formerly did in ten, and in that case the reform would be robbed of much of its economic value. I am, however, firmly of the opinion that the wage question would ultimately readjust itself, and feel justified in supporting the movement conditional upon the proportionate loss of wages. It might be urged against this, that while a mechanic receiving fair wages could get along at the reduction, the laboring man earning $1.00 or $1.25 per day is not so fortunately situated. This, I freely admit, appears to be a valid objection, and commands our sympathetic attention. But I question if at the end of the year either in the case of the mechanic or the laborer there will be any very material reduction in his annual earnings, a large portion of the seeming loss being made up by greater continuity of employment. It is but reasonable to assume, too, that as production conforms itself to the new conditions and the demand for goods increases in response to the new impulse, prices will stiffen and employers be enabled, without inconvenience, to raise the wages in like proportion. This is perhaps the most delicate feature of the problem before us and the one that will require the greatest mutual consideration in its treatment. The question of wages is often the rock upon which our good resolutions are broken, it is the one that is the most closely and jealously watched by both parties; but again I contend that consideration begets consideration, and if each treats the other with proper courtesy and respect, it is not too much to expect that even the wage question may be safely gotten over.

Another contention may be that at certain seasons it is imperative that plants be run to their fullest capacity, while at others employers might be willing to make six or even four hours a day's work. This would be peculiarly the case with the stove and heater trade; and yet, sir, I am certain that with a less spasmodic demand than that which obtains under present conditions, it would be more possible to make provision at other periods of the year for a trade that is now nervously crammed into a period of three or four months. Many of these objections that might be seriously urged against the inauguration of an eight-hour day

will be found to yield readily to the resourcefulness of a management in hearty sympathy with the movement. The great point to be made after all is to secure the sympathetic co-operation of employers. With management and working force in thorough accord, there is no difficulty that will not ultimately be successfully overcome.

There is but one other feature of the eight-hour system to which I would briefly call your attention at this time; I refer to the increased effectiveness of labor when employed for a shorter number of hours. To compute the importance of this feature would be a mere matter of speculation, and yet it is bound to prove a very material factor in the success of the eight-hour system. All who have had any practical experience in its operation agree that labor under these conditions becomes more productive, some going the length to assert that they have secured as good net results from eight hours' work as from ten hours. It is a certainty that greater rest conduces to greater effort, but with my knowledge of the physical strain already upon the molder, generally speaking, I am not over sanguine that this will prove true in his case, to any considerable extent at least. Of course new subdivisions of the work and new applications of effort may be introduced that will tend to this result, but as I say, its importance can only be vaguely computed until tested by actual experience of the operation of the system.

In conclusion I would urge upon the members of this Association that they give this question their earnest individual consideration. I would urge them to view it dispassionately from the standpoints of a business man, of a lover of his fellow man and of a citizen. Let them compute in their own minds the influence it would have in effecting a permanent improvement in trade. Let them consider its general effect upon and its applicability to their fellow man in continuing to work long hours despite the injustice wrought to so many of our citizens who have been forced into involuntary and degrading idleness and have become a charge on the charitably disposed, not because of any physical disability or unwillingness to work, but by the insane policy of

their fellow man in continuing to work long hours despite the fact that science has so wonderfully increased the productivity of man's labor that he can supply all his multifarious wants by fewer hours of effort. Having done this, then make answer to the query—shall we lend our aid in the establishment of an eight-hour work-day?

I sincerely commend to your consideration, sir and gentlemen, this important question. I trust you will approach it without prejudice and speak out freely your honest convictions. It is desirable that labor and capital should commune together and mutually assist in promoting a reform that is fraught with so much consequence to our industrial community.

I can but feebly express, sir, my appreciation of the courtesy extended to me by your Association, and my gratification at having been thus privileged to bring to your notice on behalf of an important section of your employes a subject that has now become a vital one. I am pleased to know that some of you look favorably upon the movement, and while my paper may have done scant justice to so important a theme, I look to those friends of the eight-hour work-day to keep it ever prominently before your meetings till a call shall be issued to representatives of our respective organizations to meet together to devise means and make arrangements for giving it practical effect. On my own behalf and on behalf of those whom I represent I thank you for your kind attention, and trust my effort will not prove unavailing in arousing your sympathy and securing your co-operation in behalf of the eight-hour movement, and I further express the hope that it may inaugurate a movement that will assist us in the future to a better understanding and respect for each other and our interests.

The President: It gives me great pleasure to extend, on behalf of the Association, their thanks for the able, logical and lucid remarks made by Mr. Fox upon so important a question. I have no doubt that the matter will receive serious and mature consideration on the part of the Association. I would suggest that the address of Mr. Fox be referred to a committee for action. Are there any remarks you wish to make upon that question?

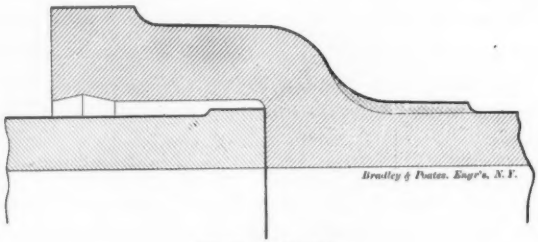
A motion was then made and carried that the paper be received and referred to a committee.

The President: I presume the Chair will be empowered to appoint a committee. Or would it not be well to refer the matter to the Committee on Defence? If there is no objection, it will be so referred. The next business in order is a paper by Mr. Groves on "Pipe Founding."

NOTES ON PIPE FOUNDING.

By S. GROVES, M. E.

The subject of "Pipe Founding," has not hitherto, received the attention it deserves. Water pipes are a necessity in every city and township in the civilized world. Indeed, one could almost take the number of pipes made and sold, as an index, of the material progress of a country. As young communities develope into highly organized populous cities, the village millwright, with his primitive cistern, ancient well, and old-fashioned hand pump, is displaced by the Civil and Mechanical Engineer, with their colossal pumping stations, extensive filter beds, broad

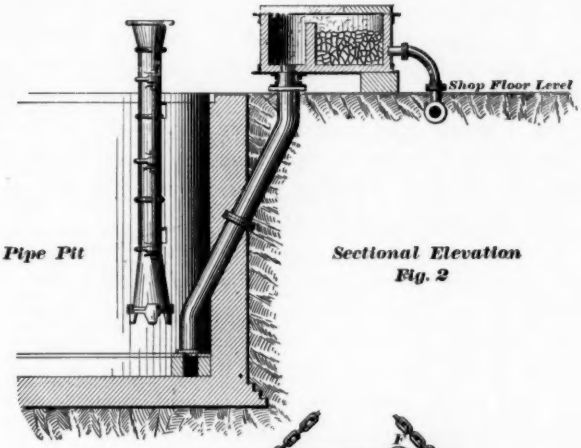


Belted Socket.
Fig. 1

reservoirs and branching street mains, through which a copious supply of water can be had at any moment, in the very homes of the people. And since the modern tendency is towards the formation of great cities, the question of an adequate water supply for the dense populations, will be an ever-increasing problem, and water pipes will be more and more in demand.

The United States census of 1890 gives the consumption of pig iron in the pipe foundries alone, as 590,000 tons; the estimated value of which, when converted into gas or water pipes, would be at the least $10,000,000. In view of the magnitude of this important industry, it is a matter of astonishment that so little has been said or written technically on this special branch

of the trade. With the exception of a fugitive article in some illustrated magazine, or journal, intended to show perhaps, what a



Sectional Elevation
Fig. 2

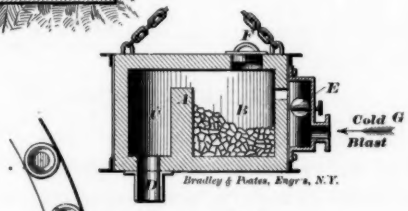
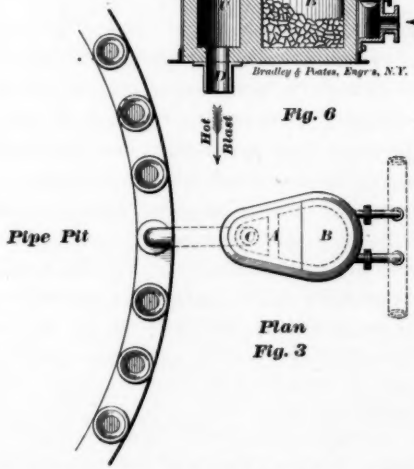


Fig. 6



Plan
Fig. 3

striking analogy there is between a pipe foundry and a beehive, very little has been made known to the uninitiated. Only

one book has been published on this theme during the last ten years, viz., Macfarlane's "Practical Notes on Pipe Founding" (1888), dealing exclusively with his own mechanical system of making large pipes, i. e., 16 in. to 48 in., and since Pipe Founding in a practical form, has never been discussed before either the National, or Local Associations, it has been deemed opportune that I should read from my note book some of the facts and data gleaned during a twenty-one years' experience in the practical manufacture of vertical pipes; in one of the largest and best equipped foundries in the world.

It is just possible, that the data I shall present, may be deemed antiquated by experts here, but my object to-day is not to introduce any thing singular, or anything new technically; nor, do I hope to exhaust the subject, but simply venture to address you on this theme, in the hope that some of the data presented, may, by the association of ideas, lead you to have a still more exalted opinion of the importance and dignity of the iron founders' business.

SOCKETS DOWNWARDS.

I may be permitted to say at the outset, that one of the chief points of difference between European and American practice is, that in the former, the almost universal custom is, to cast the sockets downwards; while in this country we cast the sockets or hubs at the top. After an enquiry into the reasons assigned for the casting of the pipes with sockets upwards, I confess that these reasons do not seem to be so cogent as are the arguments adduced for the European custom; for, if there is one part of a pipe where the metal should be close and solid, it is at the socket end—especially at the shoulder; and the pressure of the whole weight of the body must of necessity help to press the molecules of metal at the bottom into closer juxtaposition; and, moreover, tend to keep that part of the pipe clean, since the scoria and impurities in the metal will naturally rise to the top. It is admitted a simpler, and hence, more economical process for the iron founder; but the chances of defective section due to the causes indicated, are much greater than by the socket down system.

INEQUALITY OF SECTION.

Another innovation which strikes an observer interested in pipe founding is the general abandonment of the belt below the shoulder, or socket. Now, the original reason for designing the sockets in that way was, to aid shrinkage, by making the transition from the thin body to thick shoulder gradual; and it is not to be wondered at that many of the pipes rejected by the inspectors are so rejected, because of defects at the socket, i. e., granular, spongy, porous—sometimes the sockets separate from the body, whereas, if the section had been gradually increased, instead of changing abruptly, the shrinkage would have been uniform. And I may remark in passing, that this fault of unequal sectioning, is not confined to the designing of pipes, but to every branch of founding. I venture to assert, that one-half the shrinkage troubles in the foundry arise from this cause. If the engineer and the draughtsman in preparing plans, looked more to the equalization of section, there would be far less trouble with castings in the foundry.

MODE OF MANUFACTURE.*

Pipes 1ft. to 2½ ft. diameter, are usually cast on banks, at an angle of about 30 deg. They are molded in cast iron, barred, drag and cope flasks, from complete iron patterns, carefully turned and scraped, and cores made with hay ropes and loam upon hollow perforated or solid fluted wrought iron bars.

Pipes 3 ft. diameter and upwards, are cast vertically in pits; the flasks for the smaller sizes being fixed; the larger portable. In some foundries the pits are radial slots in the shop floor, the island at back having a jib crane to swing the radius of the pit; in others, the pits are circular—about 20 ft. diameter and 8 or 9 ft. deep, having as many as 50 fixed flasks, and a hydraulic double jibbed crane in the center, thus controlling the two halves of the pit without having to swing the whole circuit.

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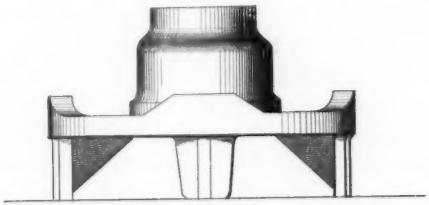
*Mr. Groves illustrated the reading of his paper with blackboard sketches, from which the illustrations appearing here have been reproduced.—Ed. Journal.

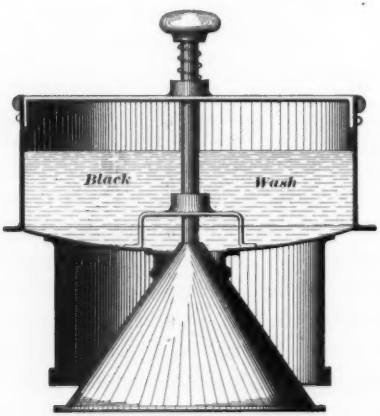
One of the best equipped shops for making pipes from 3 in. up to 9 in. diameter in 9 ft. lengths, was designed with oval pits. Each pit would turn out 80 3 in. pipes a day.

Let me now describe the various operations involved in the manufacture of say a 3 in. pipe, 9 ft. long. In the first place we have a flask fixed in the pit wall, with the halves hinged to-



Socket Pattern.

Fig. 4



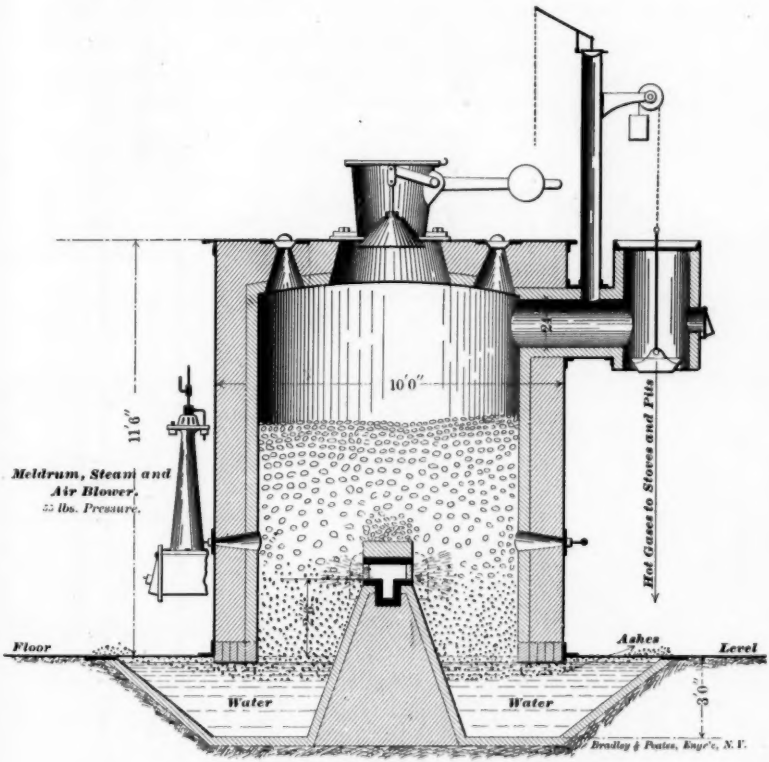
Mould Coating Valve

Fig. 5

gether. These are secured by clamps, if the concern is conservative, or by an eccentric locking device if the plant is modern.

A turned socket pattern is secured to bottom of flask, then the turned iron body pattern is lowered into flask and fitted into socket pattern. Green sand is then thrown into the mold and

rammed from above, either by hand or machine. When the mold is formed up to the top, the body pattern is withdrawn and socket pattern disconnected.

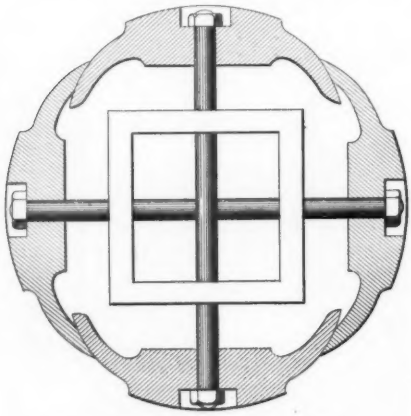


10 CWT.
Continuous, Grateless, Water-seal, Gas Producer.
(Snowdon)
Fig. 7

COATING.

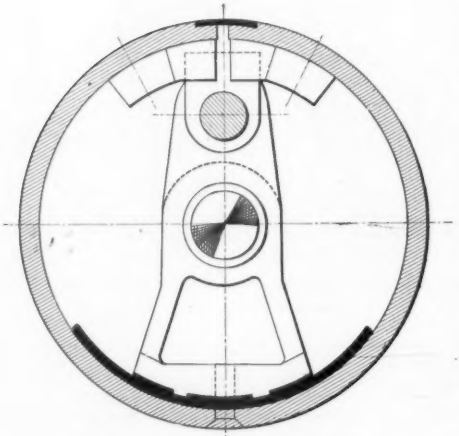
The interior of mold is then coated with liquid charcoal blacking, either by means of a long swab of flax, or by means of a special valve.

The swab leaves streaks, but the valve shoots an even stream down over every part of the mold. Surplus liquid is caught in a box below and used over again.



Segmental Collapsing Core Bar.

Fig. 8



Spring Collapsing Core Bar

Fig. 10

Spring Collapsing Core Bar.

Fig. 9

DRYING THE MOLD.

The mold has now to be dried. Various devices are in vogue for this work. I will describe two with which I am familiar. Seeing the boxes are fixed in walls of pit, it is necessary that the drying apparatus be adapted to this condition. A hollow chamber is therefore made round bottom of pit (see figs. 2 and 3), consisting of brick work covered with a cast iron plate, having holes cast in underneath each pipe flask. Hot air is

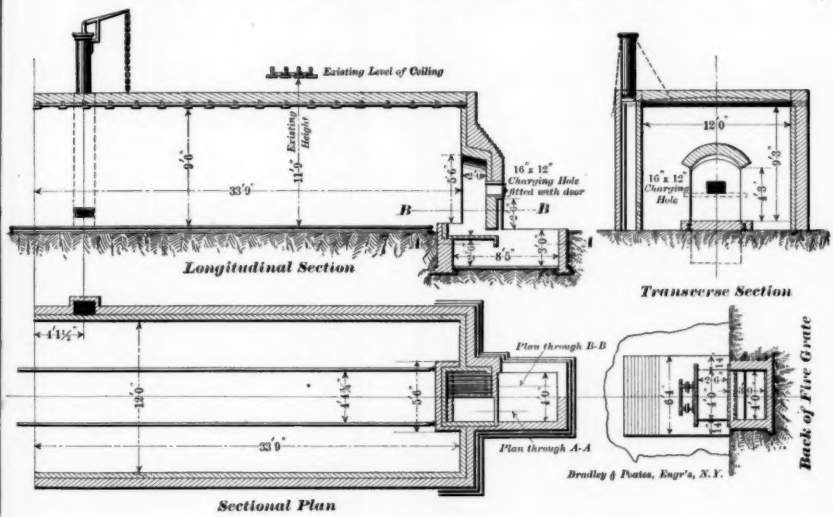
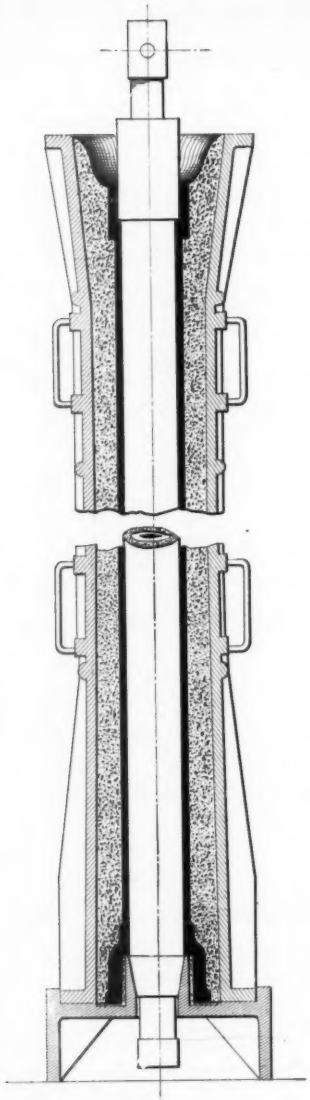


Fig. 11

CORE OVEN.

delivered into this chamber through cast iron pipes from a portable stove located at top of pit. (See figs. 2 and 3.) This device has been patented in Germany in recent years and was exhibited at the World's Fair as a modern invention.

During our visit to Philadelphia last year, I observed that one progressive firm was using this stove in a portable form, for skin drying molds in their jobbing shops, carrying it around first to one mold and then another—the fan blast being operated by a small motor.



Section of 4" Pipe Mould:
With Core in Position ready for Casting.

Fig. 11a

GAS PRODUCERS FOR DRYING.

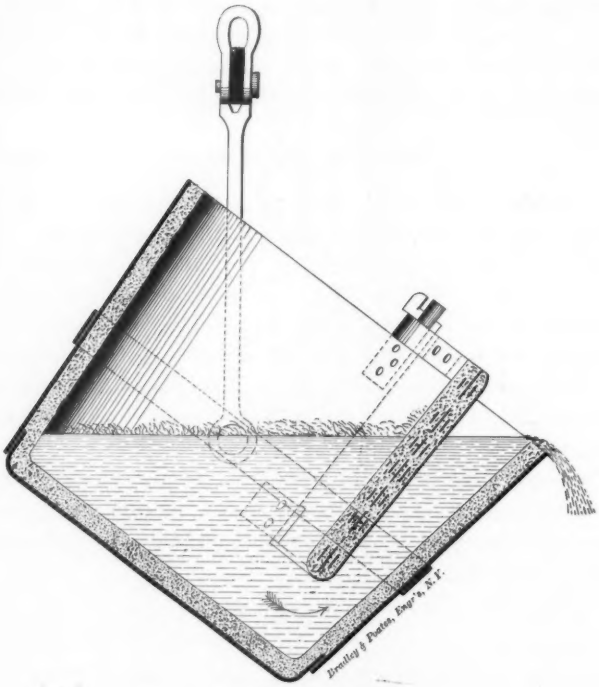
A still later and better arrangement is to locate outside of foundry one or more Gas Producers (fig. 7), from which the produced gas is conveyed through cast iron mains to the various pipe pits, for drying the molds. I have seen this system operated in a large foundry with complete success; and it has the advantage of keeping the fumes from the fuel outside the shop—greatly to the comfort and health of the workmen, who have a hard time of it in a pipe foundry, under the most favorable circumstances.

MAKING THE CORES.

Having described the mode of preparing and drying the mold, we now pass on to the making of the core. We first come to the core barrel, in the perfecting of which much ingenuity has been expended. The barrels for small pipes are made solid fluted. Often the body is made of a perforated wrought iron tube, having cast iron spiders with journals at each end. This made a very light bar, but the trouble was, that the rough handling they receive at the hands of the cheap labor employed, soon damaged them, and made them out of shape, hence the common practice for the smaller cores was to make them of cast iron perforated pipes, around which, after being coated with clay wash, hay ropes were twisted and then covered with wet loam mixed with horse manure and clay wash.

It is unnecessary to dwell upon the necessity for using the hay ropes since every foundryman knows that it is intended to burn when the pipe is cast, causing a hollow space between the coating of loam and barrel. Were it not for this device, after the iron around the core shrinks, it would be impossible to withdraw the barrel after the pipe has cooled off. When medium sized pipes are cast, even with the hay ropes, the barrels refuse to come out. Hence it is that much thought has been expended in the designing of special core bars, whereby the trouble caused by the gripping of the barrel can be avoided by mechanical appliances.

One of the best barrels with which I am acquainted is the collapsing barrel, invented by Mr. Henry Cochrane some 30 years ago. (Fig. 8.) It consisted of four segments, having square spider inside, upon which were cast wedges fitting into guides cast on each segment. This central spider was moved



Section of Divided Ladle.

Fig. 12

in and out by means of a screw at one end, which either forced the wedges into the guides, expanding the bar, or withdrawing it, and thus collapsing. Before the hay bands and loam are put on the bar, it is expanded, and no sooner is the metal set in the mold after casting, than the screw is operated, wedges withdrawn, barrel collapsed, and lifted freely out of the flask, and

cooled off with clay wash, ready for another core making. These bars were almost perfect for their purpose, but the operating mechanism being of necessity very delicate, they were continually being broken, consequently were costly appliances. The percentage of breakage, however, was reduced to a minimum, by casting the various parts with a metal mixture containing from 10 to 15 per cent. of steel—punchings from the best boiler plate.

But admirable though these segmental collapsing bars were, for pipes ranging from 6 in. up to say 24 in., they were altogether too costly for pipes above this, so another bar was designed, much simpler in construction, cheaper in manufacture, and equally effective in operation.

A perforated cylinder was cast, then put on the planer, and three-eighths of an inch planed out of one side, the whole length of the barrel, cast iron brackets were securely bolted into each end, having turning spindle in center and sliding bars at top, with wedges cast on at various stages, fitting into guides bolted at shell, the slot being covered with a wrought iron plate.

If a core is about to be made (fig. 10), the nut is turned by means of a box spanner, which draws the bar forward, opening the slot to about 1¼ in., making the barrel oval, but this irregularity is overcome, by a coating of loam and horse manure. Forty-two inch pipes now lying underneath the streets of Montreal, were made with core barrels of that design.

DRYING THE CORES.

The cores are placed on rack carriages, run into the core oven and dried, then brought out, coated with black wash—pulverized charcoal and clay wash—then put into the oven again for final drying.

The mode of heating the ovens with which I was familiar was, in one plant, by means of a coke fire. In another well-ordered establishment the ovens were heated by producer gas—from the same producers which delivered hot air or gas to the pipe molds in pits.

The molds and cores having been prepared, a kellet, or core bar seating, swept in loam, is bolted to the bottom of flask, and core lowered into same.

A dry sand cake ring is then inserted at top of mold, runner gate of green sand prepared, and everything is ready for pouring.

In one first-class pipe foundry I know of, the metal with which the larger pipes are cast, is run directly into the ladles from the blast furnace, and very excellent results were obtained in the shape of strong, clean metal. Phosphorous is the bane of the steel manufacturer, but a high phosphorous iron is just the thing for pipes, since it is an excellent preventative of oxidization. A good ladle (fig. 12) used by some pipe foundries, is spoken of very highly. It has a division in the

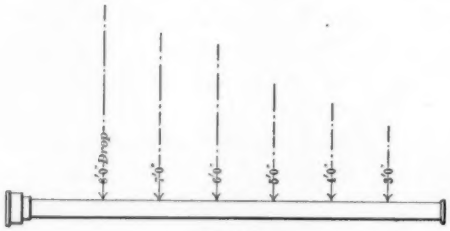


Fig. 13

middle which keeps back scoria and dirt. The principle of taking metal from bottom of ladle is a good one, and is adopted by most steel plants.

When pipes have become set, core bars withdrawn and newly cast pipes have become nearly black on the body, and grey at the socket, they are lifted out of the flasks and cleaned, care being taken to leave no patches of sand on the outside, for, in the cooling, the molecules of metal arrange themselves in an imaginary line around the sand patch, due to difference in rate of cooling; and instances are on record where such defined patches have blown out a long time afterwards; they are then rolled on iron gangways down to the hydraulic testing apparatus, where, if it is a 12 in. pipe, pressure is let in from the street main, and then

hydrostatic pressure up to 300 pounds per square inch is applied by gauge.

HAMMER TEST.

The inspector then takes a 1½ pound hammer, and while the pipe is under hydraulic pressure, strikes a series of blows along the body. This is one of the most dangerous and hurtful practices known in the trade. Many a pipe which would not leak prior to the blows, has become chronically defective afterwards. In 1889 I conducted valuable experiments, which demonstrate this. A 4 in. pipe, 9 ft. long and ⅜ in. thick was placed in the hydraulic testing machine, and subjected to a water pressure of 260 pounds per square inch, and while under this bursting strain, a ball 1½ pounds was let fall upon a chalk

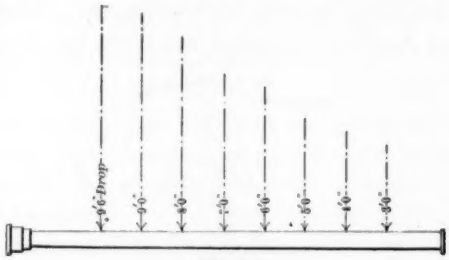


Fig. 14

line mark on body of pipe, at given points and varying heights. The pipes were then taken out of the press, and broken longitudinally into two parts, when a remarkable phenomenon was revealed. On the inside of each pipe, at the points where the ball had struck upon the chalk line, was a star-shaped fracture. (Fig. 15.) The fractured half of each pipe was then broken into two parts, and each piece upon which a blow had been struck carefully broke through the star-shaped fracture; to our astonishment, we discovered in each section, an oxidized fracture penetrating through the inside skin of the pipe into the body metal. (Fig. 16.) In no case was the depth less than 3-32 in., the greatest being 5-32 in.

The striking of any hollow castings which have to be subjected to high pressure, is a dangerous custom, and doubtless

many a good casting made in the jobbing foundry also, has become defective, through the violent use of heavy hammers, or ends of crow-bars, in the effort to jar out internal sands, core irons, etc.

GAUGING.

And not only are the pipes proved by a hydrostatic pressure, but are carefully gauged, to ensure standard diameters, even thickness, etc. It is said, upon good authority, that one-third of the pipes cast in an average foundry are condemned by the inspectors representing the purchasers.

SIDE BULGING OF PIPES.

Speaking of inspectors, I remember an important contract for large pipes, 54 in. diameter, 1¼ in. thick. Before entering the hydrostatic press, they were gauged by a bumptious inspector as to diameter, and he reported that the pipes were all

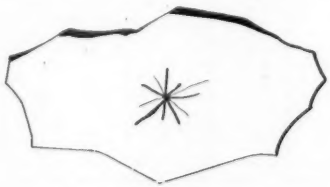


Fig. 15

oval, and sure enough, upon measuring inside at spigot end, it was found that the horizontal diameter was considerably larger than the vertical diameter. Then began theorizing as to the cause, and all was excitement. But a workman with quick perceptive powers, quietly suggested that the pipe be measured vertically and horizontally, carefully marked and rolled a quarter turn. This was done, and to the astonishment of everyone, the vertical diameter now became the same as the first horizontal, and the horizontal the same as the first vertical. The pipes had simply bulged sideways with their own weight.

COATING.

The pipes having successfully passed the gauging of the inspector, and hydrostatic test, are now conveyed, or rolled, into

a hot oven, where they are heated to a temperature of 420 deg. F., and immersed in a bath of coal pitch varnish, consisting of two parts tar to one of gas oil. The best preparation is made in accordance with Dr. Angus Smith's formula, invented some 30 years ago. This varnish is not only a preventive of rust, but hinders tubercular accretions and is at the same time an excellent antiseptic. It is mainly in this matter of coating that cast iron pipes have so far, generally withstood the strenuous effects of the structural steel and iron manufacturers to run in the

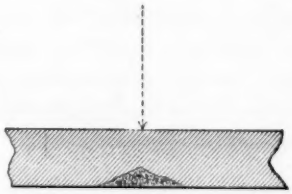


Fig. 16

built pipes, and run out the good old system of cast iron for water mains. No cement or varnish has yet been discovered, which will not peel off a steel or wrought iron pipe after being buried in the earth for a considerable time. The hard polished scale on the steel and wrought iron plates, due to rolling, prevents the adhesion of coal tar varnish, while all other cements, etc., have proven, under careful tests, to be physically injurious.

CONCLUSION.

From the phenomenally low prices at which pipe contracts are taken in these days, it might be inferred that the manufacture is correspondingly unimportant, involving little skill and resource. To reason in that way would be a great mistake. Very few jobbing foundries are equipped as yet with tensile and transverse bar testing machines, but every pipe foundry in the country is forced to have a complete outfit in this respect, since all pipe contracts are let on conditions not only of accurate gauging, and hydraulic pressure tests, but from the same metal from which every day's cast is made, specified tensile bars, to withstand a breaking strain of 14,000 to 18,000 pounds per square

inch, and transverse bars, 2 in. by 1 in. section laid flat on points of support 2 ft. apart must carry a load of 1,900 pounds, with a deflection of 5-16 in. before breaking, are insisted upon. These severe measures of protection are necessary, when it is known that the bursting of a street main has caused $10,000 damage, through cellars being flooded and merchandise damaged before the main valve in the section could be closed. A transverse test is essential, owing to the heavy loads which pass over the ground, under which are laid heavy water mains; therefore, the pipes must be able to stand severe shocks and transverse loads. It is remarkable what a heavy transverse load even small pipes will carry without breaking. In 1885 I conducted some interesting experiments; a series of pipes were placed horizontally upon rests 8′ 6″ apart, and a load applied on the middle. The following is a tabulated record of the results:

Date.	Diameter of Pipe.	Weight of Pipe, lbs.	Weight applied at Middle, lbs.	Deflection.
Feb. 18, 1885.	8″	431	11,144	4 29-32″
	7″	336	7,896	4 7-8″
	5″	237	3,916	4 7-8″
	4″	175	2,296	4 13-16″
	3″	133	1,400	4 3-16″

With these facts, I must draw to a close my necessarily superficial and imperfect sketch of the great industry of pipe founding. Although trained to the profession of mechanical engineering, my warmest sympathies and inclinations are towards the foundry. I beileve it is in the blood, for I come of a race of foundrymen; and I shall be glad, if my contribution this day, leads anyone here to have a still higher regard for, and take a deeper pride in, the business of iron founding.

The President: The paper of Mr. Groves is before you for discussion. If there is no discussion, the next business in order is the report of the Committee on Amendments of the Constitution. The committee is ready to report, and the Chair will receive the report.

Mr. C. H. Carver: In appointing a committee for the revision of any constitution of this character, the road is open very wide for sweeping changes. This has been made evident by the several resolutions of an important character that have been offered before you and by you referred to this committee. We have also, in conference with a great many of the representatives here, been advised by a large majority of them of the existence of a necessity of radical changes in the Constitution of the American Association. Not that they did not approve of the Association as it now exists, but they wished to enlarge the scope of it, and to amalgamate, perhaps, the different local organizations into one association of which the American Association would be the head. After careful consideration of this movement, however, we did not feel it would be wise to take such extreme measures, and we have adopted a medium course, which we think will be satisfactory.

REPORT OF COMMITTEE ON CONSTITUTION.

To the President and Members of the American Foundrymen's Association:

Gentlemen:—Your committee, appointed to consider the revision of the Constitution, and to whom the various resolutions pertaining to the same have been referred, have duly considered the subject after consultation with representatives from the various local organizations, and find almost a universal sentiment in favor of some reasonable method of bringing the foundrymen of the United States in closer touch with each other, so that they might receive the benefit of a ready exchange of ideas. To accomplish this, however, and make the American Foundrymen's Association the parent or leading organization, as some have proposed, radical changes of the Constitution would be required; changes which we cannot consider at the present time, for two reasons:

1st. Any move toward uniting to any degree or amalgamating the different local organizations must, to be effective, first have the approval of the local organizations.

2d. The interests of this Association would be involved to so great an extent that we do not deem it wise to proceed in that direction, except with great deliberation.

But, however, as an initial movement in this direction, so far as can be done with safety, and to subserve our best interests otherwise, we beg leave to report in favor of the following amendments to the Constitution:

Amend Section 2, Article II., to read as follows:

ARTICLE II.

Section 2. Any person, firm or corporation engaged in the production of castings of any kind, as employer, superintendent, foreman or chemist, may become an active member when approved by the Executive Board; and any associate member may become an active member when recommended by the Executive Board and approved by a majority vote of the Association at any annual meeting.

Also amend Section 1, Article III., to read as follows:

ARTICLE III.

Section 1. Each person, firm or corporation, who may be elected to either active or associate membership in this Association shall pay to the Treasurer advance dues for the first six months before a certificate of membership shall be issued to him or it.

Also amend Section 2, Article III., to read as follows:

Section 2. The annual dues for each active or associate member of this Association shall be ten (10) dollars, payable semi-annually, in advance; provided, however, that to members furnishing satisfactory proof of membership in some local foundry association, one-half the annual dues shall be remitted.

Also amend Section 1, Article VII., to read as follows:

ARTICLE VII.

Section 1. This Constitution may be amended at any regular session of the annual meeting of the Association by a two-

thirds vote of those voting; such amendments having been proposed in writing at some previous session of the same or previous annual meeting.

Respectfully submitted.

G. H. CARVER,
WM. H. CARPENTER,
WM. YAGLE,
Committee.

I may here state that if the Western, Philadelphia, New England, and Pittsburgh Associations will meet us half way, we may all get together and feel that our interests are in common. We have taken the initial step here, and possibly if the organization will adopt the clause under which any member of a local association of good standing may become a member of the American Association at one-half the annual dues, it will result very much to the advantage of all concerned.

Mr. Frank: I move that the report be adopted.

Mr. Penton: Before the motion is put I would like to know if everybody is satisfied. I remember, in Philadelphia, we had to go back again all over the business of settling the Constitution. I do not criticise anything, but just want to know if everybody is satisfied. I think all who have followed the proceedings will see the wisdom of the recommendations. The reduction in dues, the recognition of members of local organizations, is undoubtedly wise, and seems to meet the approval of a good many of the members who have been conferred with in regard to those changes. The change of Section 1, Article VII., is one which we have found very necessary during the past year. As we go along we shall find the necessity of certain corrections and changes, but they cannot be made without seriously interfering with the Constitution as it exists, although in this case we have authority for making a change at this time under the Constitution.

Mr. Best: I approve heartily of the suggestions made by the committee, but I think they should be put in process of adoption. In the interim, we have a clause in the Constitution requiring pay-

ment of $12 dues. I fear from intimations I have discovered we shall have a very limited membership for the coming year. I do not know of any way to overcome the difficulty. I only wish to call the attention of the Association to the fact. Of course, those who have been members heretofore, will not have to pay any kind of initiation fee, but new members will be required to pay an initiation fee of $5 and $10 for dues. Individually, I do not object to it; but I fear we shall have trouble in upholding our membership. Another thing to be considered is whether $10, as proposed in the amendment, is not more than is necessary. What we want more than anything else is an enlarged membership, not a large sum from a small membership. I was rather of the opinion that the committee would seek to cut the dues in two, making them $6, in order that we might have a much larger membership, although the revenues may be no greater than the present sum. These are the only things I see to call attention to at present, and probably my remarks will bring out some further expressions in order to know whether the change is really what we want. I fear, as Mr. Penton put it, that we are going to adopt these amendments rather hastily. I do not want to criticise anything, but merely give out these ideas to prevent further discussion on other points.

Mr. Northrup: We are a little out of order. The motion was made that the report of the committee be adopted, not that we should discuss the Constitution. The matter of the changes should go to a vote later. I move the previous question.

The Chairman: The gentleman's point is well taken. The motion is to receive the report of the committee.

The motion was agreed to.

Mr. Yagle: In answer to Mr. Bell in regard to dues I would point out under this change as a member renews his membership he only pays $5, providing he belongs to a local organization. If he does not belong to a local organization the dues to this Association will be $10. Mr. Bell seems to be under the impression that the dues will be $12 with an initiation fee of $5.

Mr. Bell: The point I make is that the constitution is not changed by the passage of this resolution. This amendment cannot be adopted for twelve months yet, and the constitution remains as it is. I wish to call attention to that fact. In order to continue a membership for the coming year it will be necessary for the members to pay $12, whether belonging to a local organization or not. I fear we shall have a limited membership. I do not say that these gentlemen in making their report should change that, but I wish to call the attention of the association to the fact that that is the state of affairs, and probably I correct a wrong impression. The membership fee for those who are members of the local organization will be only $5. Now, I fear I am treading on dangerous ground, but we all should look at facts, we have been long enough together to appreciate one another. There are but five local organizations in this country. The objection to the purely delegate association was that you were turning the entire American Foundrymen's Association over to these five associations, whereas the principle adopted before was that it belonged to the foundrymen of the United States of North America. Now, whether it will work well or ill we are tending towards that thing if it is our purpose to turn this association over to a delegated convention with a representation only by members of the local organizations, I fear we have missed the object we had in view when we started out. You cannot expect independent membership to come in at a disadvantage to some other people. The gentleman belonging to a local association pays his dues because the association is a benefit to him. If that association is of sufficient benefit to justify his being a member he joins it and pays his dues. He comes to the National Association and joins it because it is a benefit to him, and because it is worthy of all his contribution. Now, the independent member who cannot be a member of the local association, is at a disadvantage. Whether it is for the better I am not prepared to state, but I rather think that the local associations are asking a little too much from the independent membership in this association.

Mr. Northrup: I do not understand your construction of Article 7 to be correct; it seems to me that this is one regular session, and to-night we may have another. We are not obliged to wait twelve months. I should like to hear from some one else on this subject.

The President: The Chair would rule that we have the power to amend the constitution because notification was given at a regular meeting, and at a following regular meeting we are at liberty to adopt any amendment proposed. We have had four regular meetings so far.

Mr. Yagle: That was the feeling of the committee and we expect naturally to have the matter acted on before we adjourned, and not wait twelve months.

Mr. Bell: Now, Mr. Chairman, that raises an important question, and I suppose we are all willing to take the ruling of the Chair on it. I think I will support the Chair—if any person undertakes to differ with him. By ordinary rule of construction, however, this would mean that we can propose an amendment at this session, and it can be acted upon, and must be acted upon, the next. That would seem to be the idea. Of course we can have the ruling of the Chair and if any person differs with him he can ask to be sustained by the association, and I am willing to support the Chair.

The President: I would explain the rulings of the Chair. Notwithstanding parliamentary usages there is still another law, and that is the law of common sense. The majority will agree with me that common sense has been applied by the Chair in his ruling. Is there any further discussion of the report? If not, adoption of the amendments will be in order.

Mr. Frank: As a member of the Pittsburg local I suppose I should be in favor of the abolition of half the dues to this association, but I agree with Mr. Bell that we should be delegating the rights and privileges of this National Association to the few local associations, to the detriment and hardship possibly of the

numerous members. It would necessitate higher dues to these members, and in that way it would be a hardship, and we might lose a good many desirable members in that way. I believe the hardship on those belonging to the locals would not be great for they would really derive sufficient benefit to cover the dues in their local association and the National Association. The American Association should have the support of every gentleman desirous of becoming a member of the National Association and share equally in its expenses. The Journal published by the association is compensation enough if the member does not attend the meetings. It is quite sufficient compensation of the payment of his annual dues. If we cannot get along with $10 as annual dues, and with members of local associations paying only half, it would seem wise to reduce the annual dues for the entire association and make every one stand on his own footing. I would, therefore, suggest that the committee consider that matter. They have probably made some figures to cover the annual expense, and they might suggest a figure, or some suitable sum for all members to pay.

The President: In reply to Mr. Frank I would suggest to the Chairman of the committee the consideration of the suggestion made. How would it do? There is apparently a desire to reduce the annual dues. Can you answer that question, what is your view concerning the reduction of $6 as Mr. Bell recommended making them that sum instead of $10.

Mr. Carver: I can only say, as a member of the Western Foundrymen's Association, our dues are $10 a year. If we want to become members of the American Foundrymen's Association, we must pay an additional amount. Our idea is not to accumulate a large fund, but accumulate a large number of members in the American Association. We would rather have the same amount as at present with double the membership, rather than have it remain as it is. But it seems to be impossible under existing circumstances to even retain the present membership of the American Association, by continuing the dues as high as now, and in addition thereto to have a $5 initiation fee. Now,

we would say that a member wishing to join the American Foundrymen's Association with the by-laws or constitution as at present, he must send his check for $5, accompanied with his application, then when he is elected before receiving his certificate, he must send $12 more, which makes $17, to become a member of the association the first year. With the proposed amendment as we have placed it, the cost to any one wishing to become a member of the American Association will be but $10, and that need not be paid until after he has been notified of his election as a member of the association, and then he can send his first six months' dues, which would be $5, in case he is not a member of any local association, and half that amount if he can show that he does belong to a local association. We think we shall have to pay $10 or more to get the benefits of the ideas of the Foundrymen's Associations. You Philadelphia people will have to pay it, you Pittsburg people and you New England people. Even if we reduce the dues in our locals we shall have to pay $10 or more to get the ideas of the foundrymen of the United States, and it seems that is why the members of the American Association should be willing to pay $10 a year, and if they can't get that much good out of the association they had better stay at home. To expedite matters I would suggest that you have your secretaries read each clause as proposed to be amended and submit it to the association for adoption or rejection.

President: The motion before you is the adoption of the amendments by paragraphs.

Mr. Bell: I do not want to be a disturbing element, but would say this, that this by-law clearly in its most literal construction requires this amendment to be proposed at one regular meeting, and adopted at another regular meeting. You are at this meeting both proposing and adopting them.

Mr. Vrooman: As the endorser of that resolution I would say that when the convention accepted the resolution, and referred it to the committee at yesterday's meeting it was certainly evidence that it was intended to amend the by-laws at that time. The meeting of yesterday was the previous regular meet-

ing according to your construction of the by-laws, therefore the amendment can be adopted to-day.

The President: The resolution offered by the gentleman was referred to the committee but the knowledge of the amendment has only been placed before the association to-day.

Mr. Yagle: If there is to be no more regular meetings, or a meeting this evening, or to-morrow, we can adjourn now, and immediately reconvene and have another meeting.

The President: That would be in order. The Chairman will entertain a motion for that purpose.

The motion was agreed to, after which the convention adjourned.

The convention was called to order again immediatetly.

The President: The question before the meeting is the adoption of the amendments to the constitution as reported to the committee at the last regular meeting. If there is no objection debate will be limited to three minutes, except by unanimous consnt. The Chair hears no objection, therefore, it is decided. Suppose we take the report up by sections. We will take a vote first on Section 2, Article II. The Chair is ready for the motion.

Mr. Best: I move the adoption of the report as read, in regard to that section.

Agreed to.

The President: We have next Section 1, Article III. The only change is that the initiation fee is done away with entirely, and half the dues are paid in advance.

Mr. Best: I move the adoption of that amendment.

Agreed to.

The President: The next is Section 2, Article III. There seems to be a diversity of opinion in regard to that section, and the chair will be liberal with time for that debate. The suggestion has been made that the amount might have been reduced a

little, by carefully considering the expenses. Was that arrived at, Mr. Secretary?

Mr. Penton: I answered a number of questions to the satisfaction of the committee. I do not know how carefully they investigated the matter and I do not say I think it a good amendment, or a bad one. There are several considerations involved here, that may not appear to the average member of the association at first glance, and it seems to me it may not be a bad plan to leave that as it is. I have no suggestion to make on this point. I think a clause should be added here permitting us to amend our constitution between conventions if found desirable, by letter ballot, therefore if a clause like this is not found advisable it could be fixed between meetings.

Mr. Johnston: I should like to ask how many of our 500 members belong to no organization.

Mr. Penton: Of the 500 people who applied for membership possibly 75 belonged to local organizations. That is about 15 to 18 per cent. While the number of those who have applied for membership and have paid their dues amount to about 25 to 30 per cent as belonging to local organizations, thus showing that the man who belongs to both is the better member. I might say a man who belongs to a local association is more apt to belong to the National Association than the man who does not. A firm which tries to do all they can in regard to keeping up to the times can be induced to join this association or any other, five times easier than the firm or corporation which does not believe in anything, or does not join anything. It seems to be the policy of some concerns not to join anything. I think the membership belonging to local associations would be the most apt to join this association, and would do so under this clause.

The President: The information obtained here in the last two or three meetings in some of these papers were so valuable that some who got them would not sell them for a great deal of money. There is a value to be attached to that condition. I belong to an association and lost one of the numbers of the pub-

lished transactions of that association and was glad to pay $7.50 to get a duplicate copy, while the dues for the whole year are only $15. That applies to this association too. So the question then is the adoption of Section 2, Article III., as amended.

Mr. Penton: Some may say they do not care to join our association, or belong to any other association, but they are glad to read what they can of our proceedings.

Mr. Jones: I thought possibly there was a larger percentage of this association belonging to local organizations, and if that was so I could not see why this association could afford to reduce the dues. As I understand the report of the treasurer there is about $600 in the treasury. Can Mr. Penton give us an idea as to how many members he expects to gain this year. Can he manage things without having a deficit.

The President: The assets are something like $1,800 if the dues are all paid up. There is still an indebtedness we have to meet that amounts to probably $600, but the cash assets should be about $1,800, so that apparently the dues from the past year have been sufficient to meet all liabilities and leave a little surplus. We are reducing that now. We are getting rid of the initiation fee and reducing the dues from $12 to $10.

Mr. Bell: I do not like to repeat remarks made in regard to this matter. I rise now to say that I have not changed my opinion in regard to the facts of this legislation, and my fears are that you will dissolve this thing entirely in the hands of the local organizations, which are few in number, and do not represent to any large extent the great body of American foundrymen. I understand the argument very well, and as far as I am individually concerned I yield to the committee, but you have got to renew by payment of dues the membership of this association. In sections and cities where there are no local associations you charge $10. Local associations pay $5. I do not say it is wrong, and I am not complaining. What I do say is that it will be very difficult to convince those people and make the association of that extended value that it was originally intended it should be. I think I express the views in this regard of a great many who are

here, and who hesitate themselves to make the statement, and for that reason I leave the matter to the convention.

The President: I have thought over this matter since yesterday, and I agree with what Mr. Bell says. We have still to reach 2,500 establishments in the United States, that is out of 3,500. If we have their moral support and can only get it by reducing the dues we should do so, and it will be worth a year's trial anyhow. I just submit my individual views in this way.

Mr. Vrooman: Mr. President, in regard to this association losing any money by adopting this amendment such a state of things is in my mind impossible. We, as members of the Western Foundrymen's Association pay in as dues $10 a year. We have 105 members, or more, and if by this amendment those 105 members can join the American Association without additional cost to them these 105 members and their $500 will increase the income of the National Association $500, which might be cut off now from your former membership. The Philadelphia Association have something in the neighborhood of 100 members and that practically would mean another increase of 100 members and $500 a year. In all localities where there exist no associations, for instance Detroit, there will be associations formed when it is found that it costs no more to maintain two than one. I think the American Association would be benefited by this amendment.

Mr. Penton: A gentleman asked me a question a moment ago. It is my experience that the secretary of this association could set himself to work under the proposed amendment to raise a stated sum of money and could do so easier than under existing circumstances. We have no initiation fee, and the dues are only $10 a year, and to a man who is a member of a local association it is only $5 a year, and members of the local associations will feel more kindly towards us.

The President: You think your experience will enable to profit by this amendment.

Mr. Penton: I will tell you. A large number of people engaged in any field act themselves according to what other people

do. Hundreds are watching what this convention is going to do, and as soon as they find the movement popular they will submit. Another thing, the more members we get, the more will be found out in regard to the value of our monthly transactions, as they pass around from hand to hand. It will be considered necessary to belong to this association. I believe it would be an enterprising way to raise money for this association, and make it easier to collect back dues.

Mr. Best: I think there is another view we should take of this matter. A local association will perhaps delegate one of its members to become a member of this association, and by so doing they will get all the valuable information, the same as if the whole membership of that local association had become members. They will merely pay the annual fee of $5 and obtain the same benefits as those who pay $10. I have been trying hard to get the local members in Montreal to belong to this association. I can perhaps now say the fees have been reduced to $5, and I can say to them, you here in Montreal and others of you who come from a radius of 100 miles of the city can have all the advantages of the association as members by paying $5 each. I have two or three in my mind who will suggest that we delegate one man as a member so that we might receive all the benefits of the association of that one fee of $5. They would get the benefit by one member of the association receiving all the information which would then be given to other members of the local association. They would say to that member, "You are our delegate, we pay this association fee for you, you belong to our local, and all the information you get belongs to that local." Therefore they receive the full benefit just as though every member had joined the association.

Mr. Metcalf: Our firm has a membership in the local association and there are lots of members of our local organization here, men who know ten times more about foundry practice than I do, and are better able to come here and get all the good out of the convention. I would not for ten times the amount of the initiation fees have missed coming here, because these people know so much more than I do about the foundry business. They

would not look at the little things I wanted to know. I am willing to pay the $12 personally to find out something I want. It does not matter who the delegate from Pittsburg is, he would not find out what I wanted to know. I do not believe one delegate from any place could satisfy all the members of his local association.

The President: It has been moved that Section 2, Article III., as amended, be adopted.

Motion carried unanimously.

The President: The next question is the adoption of the amendment to Section 1, Article VII.

Mr. Bell: I move that the amendment be adopted.

Mr. Penton: Mr. President, here is an idea. Supposing something happens in the course of the year to make necessary an amendment to the By-Laws. Would it not be a good idea to amend By-Laws, if found desirable, by a two-thirds vote by letter ballot? I just throw out that suggestion.

Mr. Bell: I hope the committee, and the association members who are voting so unanimously are not afraid of their actions. While I have thought it was something wrong, I am willing to abide by it for a year, but whether the association can live through it is another thing. If none of the members are afraid, I think a scheme of that kind would be quite proper.

The President: You know, Mr. Bell, a good many organizations similar to this have found it necessary to provide for such a contingency, and by doing it by letter ballot they obtain absolutely a two-thirds vote, so that there is no danger of throwing over the constitution for the benefit of a faction. The Civil and Mechanical Engineers have been in existence for quite a number of years, and they found it necessary to have just such a clause as that, and the Secretary has been wise in suggesting it. It does not endanger the constitution.

Mr. Bell: The only thing is, it does not give the minority a day in court. They have no opportunity of making their state-

ments. In the opposition there might be some parties who have opinions, and if they were properly expressed the vote would be different. You do not give the opposition or minority a chance to state their objections, that is why I object to it.

The President: You emphasize what you say right here, because you have changed my views right away, the question is now the motion for the adoption of the amendment.

Motion duly seconded, put and carried unanimously.

Mr. Bell: I move that these amendments be now adopted as a whole.

Motion duly seconded, put and carried unanimously.

Mr. Penton: In regard to the Committee on Defence, Mr. Pfahler, the chairman, was summoned home on important business, but Mr. Yagle is here and will make a report in his absence.

Mr. Yagle: I had no idea the chairman of this committee would be absent this morning. In his absence we thought best to circulate petitions among the members here with a request that they sign. The heading of the petition is this:

REQUEST FOR THE FORMATION OF THE AMERICAN FOUNDRYMEN'S PROTECTIVE ASSOCIATION.

"Believing that the formation of an association for protective purposes among the foundrymen of America would be productive of much benefit to all interested, we hereby agree to assist in the formation of such an association.

It is understood that we are not in any way bound to permanently support such an organization, but only temporarily lend our aid in order to facilitate the preparation of the necessary laws, etc."

The petitions are signed by a number of people, and in order to bring up this matter and put it in proper shape, I would move that a committee of five be appointed, with Mr. Pfahler of Philadelphia as chairman, to take up the matter and formulate a plan for the operation of a Protective Association within the lines of the American Foundrymen's Association.

The President: I hope some one will amend that motion so as to continue the present committee. We could not get a better one.

Mr. Lanigan: Before that motion is put I would like to state that I hope somebody will be substituted in my stead on that committee, for the reason that I am in a remote corner of the earth, 26 miles from Boston, and Boston being a very prominent center around which everything radiates, the President of our New England Association is located here, and other gentlemen more fitted for the position and who have more influence than I. Consequently, I should like to be relieved from serving on the committee.

The President: At the request of Mr. Lanigan, I will substitute in his stead Mr. Geo. H. Gibby of Boston, President of the New England Association.

Mr. Gibby: While Mr. Lanigan is 26 miles away, we always hear from him.

The President: I think you might allow the chair to be autocratic in this matter, and continue that committee. What would be the duties of this committee, Mr. Yagle, to formulate ways and means?

Mr. Yagle: That was my motion.

The President: Then why not change your motion that the committee might be one of seven?

Mr. Yagle: I will make that change.

The President: The motion is that a committee be appointed consisting of seven members to formulate ways and means to bring about the organization.

Motion put and adopted.

Mr. Northup: I would first move that the report of the committee as read by Mr. Yagle be accepted, filed, and adopted.

Motion duly seconded, put and carried unanimously.

The President: The committee as it now stands is as follows: W. H. Pfahler, E. H. Putnam, Wm. Yagle, H. M. Leland, Alexander Jarecki, Geo. H. Gibby, Ed. Maher

The President: Mr Yagle, as a member of the committee, you can possibly give this information. I presume that the committee eventually will report to the Executive Committee of the Association. We shall adjourn in a short time, and during the year they will probably act. I presume it will be by reporting to the Executive Committee that the Defence Committee will act, and that the Executive Committee will issue the report to members.

Mr. Yagle: That will probably be the way, we shall meet on the call of the chairman, and that will probably be the method adopted.

The convention then adjourned.

RECEPTION.

On Wednesday evening the local foundrymen and the entertainment committee tendered a reception to the visitors at Harmonie Hall, which was largely attended by members of the American Foundrymen's Association and by many of the stove founders, who were in attendance at the convention of the N. S. F. A.

THURSDAY MORNING SESSION.

The convention was called to order by President Schumann, and after routine business the following paper was read:

FOUNDRY ELEVATORS AND YARD CRANES.

By G. A. TRUE.

The foundry is about the last branch of iron manufacturing business to widely introduce mechanically operated machinery. The naturally conservative spirit of the foundryman has, in the past, been fostered by the tendency in large plants to buy the latest machinery for the machine shop and the erecting shop, but to let the foundry (often the best paying branch of the business) get along with what it always has worked with. During the last decade, this spirit, or lack of spirit, has largely disappeared, and all new plants, as well as many old ones, have utilized the most improved power operated appliances obtainable. This has been true especially in the foundry proper. The moulder has been given improved cranes, ladles and molding machines. But there are still some ragged edges. The yard, however, is often sadly neglected, and there the management often satisfies its philanthropic energies by the employment of a large laboring force under the excuse that "a lot of men have to be kept around anyway." Considering the amount of material handled in the average foundry yard and the expenditure of power in hoisting the stock to the charging floor, it would seem that here is one portion of the plant that should receive more consideration.

The elevator portion of this paper will probably not interest those fortunate foundrymen who have located their plant on a hillside and for whom an obliging switch engine gently elevates their iron in car load lots to stockyards level with the charging floor. This is an excellent scheme from the manufacturer's standpoint, but the foundry Mahomet cannot always go to the mountain; so it often happens that the crane builder or the elevator builder must come to the foundry. It is probable also that the foundry of small proportions will be less concerned in the subject than it should be. The scaffold of such foundries is often, too often, reached by leg power and profanity, rather than by mechanical power and profit.

The old style inclined plane for wheel barrows seems to have

declined to some extent, except in antique plants, and in its place the vertical "lift" has for several years held undisputed sway. These machines are of too general use to warrant a detailed description—usually some simple form of warehouse or freight elevator operated by belt or electric or hydraulic power. Of late years the non-freezing qualities of compressed air have largely superseded hydraulic power for the reason that the foundry hoist is almost invariably in a semi-exposed location and the climate is against hydraulics several months in the year. This is probably one reason for the failure of Americans to more generally adopt the simple hydraulic plunger hoists so commonly used abroad.

The ordinary worm or spur geared elevator is familiar to all foundrymen. It should be about twice as heavy throughout as the ordinary "warehouse" or freight elevator of the same rated capacity, for it is generally handled by laborers and is subjected to very rough handling. The spur geared elevator is more efficient than the worm geared machine, especially when used for heavy loads; it is more expensive too in first cost. The usual capacities are from one to three tons, with lifts of from twelve to twenty feet. An automatic top and bottom stop is usually provided, and in some cases the platforms have automatic safety dogs, although the short lift often renders these inoperative. The electric elevators are modifications of the belt power machine, the motors being sometimes direct connected and often belt connected. The steam engine types are usually direct connected and reversible. The air motor types are of similar construction and are of comparatively recent design. The more familiar type of compressed air elevator is an application of the common air cylinder hoist lifting the platform by a wire rope, either simple or compounded, passing over sheaves. This is sometimes modified by introducing the cylinder directly below the platform "plunger fashion." In some localities a hydro-pneumatic or a steam hydraulic combination can be used to an advantage; the water or other incompressible fluid being used over again and again. If water is used it should be mixed with an anti-freezing compound if in an exposed location, or in some cases oil can be used, although the

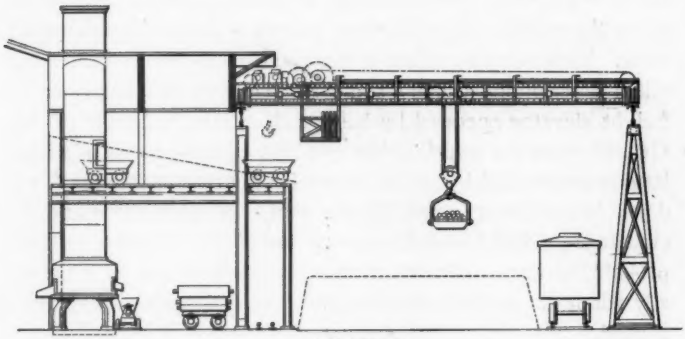


PLATE 1

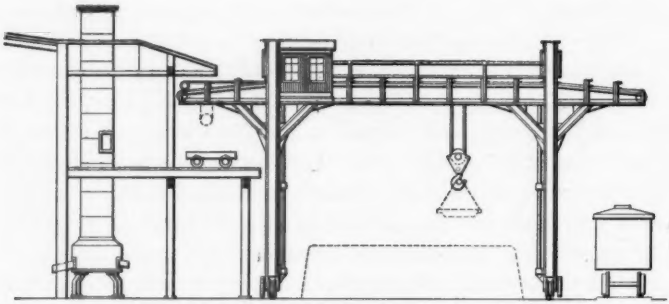


PLATE 2

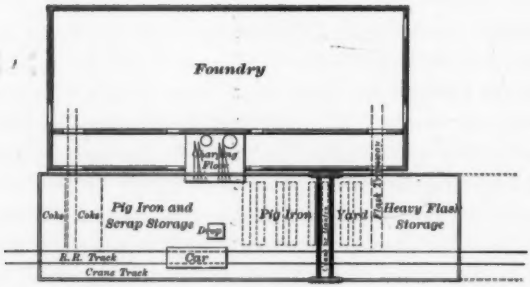


PLATE 3

proximity of the hoist to the fire of the cupola makes this generally undesirable. In some cases a jib crane has been adopted to perform the work of an air elevator and to also cover other service. In the paper on "Cranes" read last year by Mr. Outerbridge before this association, a device of this type was described. This crane was supported by a central pillar and had a radius of 30 feet, effectively covering about 600 square feet of yard service, in which the pig iron was stored. There are in St. Louis in the works of Harrison-Howard Iron Company and Missouri Car & Foundry Company yard cranes doing similar work. The pig iron is loaded on special cars, which are hoisted and swung to the platform by steam or electric power, the trucks being then wheeled to the cupola.

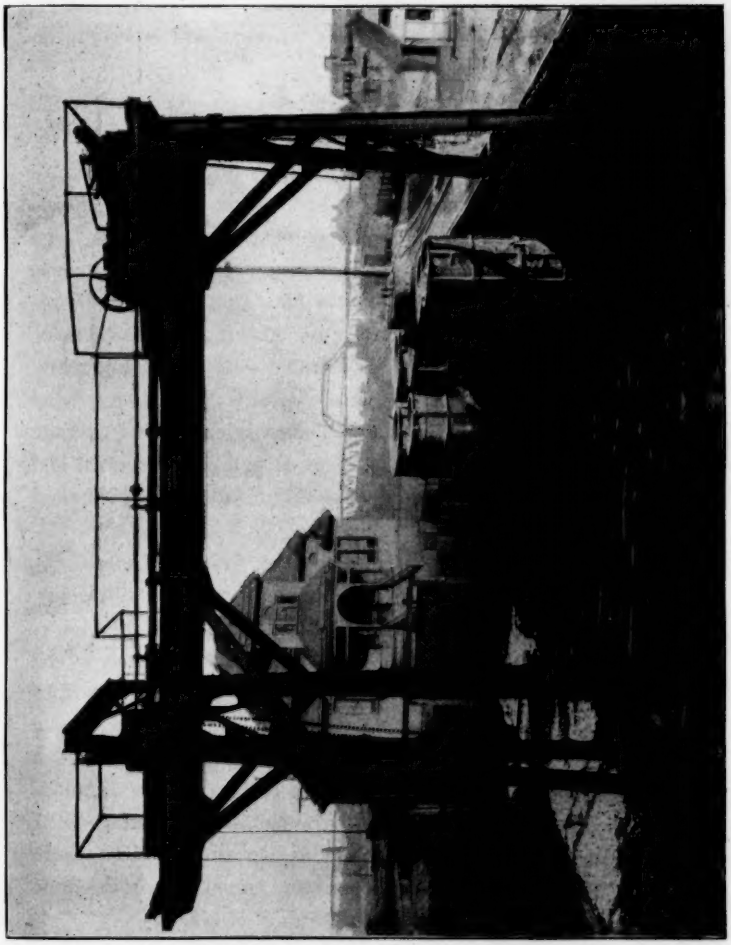
In the works of the Whiting Foundry Equipment Company at Harvey, Ill., the iron and fuel is hoisted and carried to the charging floor by means of a conveyor track and trolley running from the cupola across a portion of the stock yards, and over the railroad track, from which the stock is unloaded. The track and hoist is of two tons capacity, and both the trolley travel and lifting motion are operated by compressed air. The height of lift is about 25 feet, and the length of trolley travel over the yard is about fifty feet, with an additional travel in the charging house of about twenty-five feet. The iron is loaded on trays carried by trucks in the pig iron yard and is moved under the conveyor, which lifts the trays to the charging floor, where they are either deposited on trucks or carried by the conveyor to the cupola.

This device is in an uncompleted form as yet, the original plan contemplating the extension of the trolley track or bridge another fifty feet or more, and the storage of the pig iron in piles at right angles to and convenient to the line of trolley travel. But in its uncompleted form it has demonstrated its usefulness and versatility. It plays various roles beside that of a charging floor elevator; it serves as an excellent casting breaker or "drop," and it has on numerous occasions demonstrated its value as a loading crane where there was a run of duplicate work within its capacity. Could its range of usefulness have been foreseen when it was planned, the lifting capacity would have been greater and

provisions would have been made for its use as a loading and unloading crane for all work up to five tons weight. A similar system operated by belt power was installed in the foundry of Thomas & Son, of Newark, Ohio, several years ago and is still in service.

The ultimate efficiency of such a device and its maximum form of usefulness in serving yard and charging floor is probably embodied in a continuation of the scheme of which this is a practical beginning, and that is, the adoption of an overhead traveling power crane or traveling gantry to serve the entire yard; spanning the outside tracks, hoisting the pig iron and fuel to the charging floor, doing service as a drop hoister, a loader of moderate weight castings, and a flask crane, and in many plants a crane to unload and distribute the pig iron. Not all foundries have a capacity to warrant the investment, and still fewer have their yards so arranged that such a crane could be used advantageously, but the suggestion is presented for the consideration of those who may contemplate future plants, or whose yards are so arranged that such a scheme can be employed.

The application of a traveling crane for this service, running on elevated tracks, is illustrated in cut No. 1, and the adoption of a traveling gantry on surface tracks to work of this kind is shown in cut No. 2; while an outline plan of the system, applied to the foundry yards above referred to, is shown in cut No. 3. The method of transferring the flasks from the yard crane to the shop, on surface tracks, is indicated, as well as a proposed plan for transferring the castings from shop to the yard crane. The half-tone cut shows a gantry recently installed in the plant of Dennis Long & Co., of Louisville, serving the flask yard, with one overhanging arm which may be applied to the charging floor service. The gantry shown is of five tons capacity, the length of girder is 42 feet, the gantry travel being over 300 feet. It is operated by three independent compressed air engines, and is at present serving a flask yard only. Electricity or any other convenient power could, of course, have been successfully used. The speed for the service under discussion should be high, hoisting light loads to the charging floor at the rate of sixty or eighty feet per minute and traveling 150 to 300 feet per minute.



GANTRY, IN USE BY DENNIS LONG & CO, LOUISVILLE, KY.

The advantage of a traveling device over a swinging crane in such service is apparent. The additional ground covered, the ease of covering more area by extending tracks, and its usefulness in handling flasks, as well as loading and unloading in any

part of the yard, are considerations which fully justify the increased first cost. The modern pipe foundry yard especially offers a ripe field for such a machine.

The flask yard has long been a much neglected corner of the foundry plant. A few modern and enterprising firms have installed locomotive cranes in this service with good results, although sometimes at a sacrifice of valuable room for tracks. Many use no crane at all and a labor statement taken in some large plants showing the annual cost of handling heavy flasks by muscle would be interesting. Others have a hand power jib crane serving a limited area and necessitating the stacking of flask on flask, involving the interesting and deliberate operation of frequently removing six top flasks to get at the bottom one. An overhead yard crane of high speed and ample capacity can, in the average plant, be made to serve the flask yard as well as the cupola, and have plenty of time left to do duty as an unloader of pig iron and fuel, and a drop hoister or breaker.

In order to allow such a crane to work to its best advantage, provision for some storage on the charging floor should be made, and a multiple system of pig iron trays, or trucks, and coke buckets, should be used, thus avoiding in a measure, the delay at the loading and unloading points. Under such a system no difficulty should be experienced in handling from yard to cupola floor twenty to thirty tons of iron and coke per hour; and a greater amount hourly from cars to pig iron yard. The use of an auxiliary dumping device facilitates the handling of iron from the cars, and by moving the cars to a point opposite the place where the pig iron is to be stored, the trolley travel and hoist alone need be used then engaged in this branch of service.

The suggestion of the paper, in summary, would cover the recommendation of one or more high speed traveling cranes or gantrys for outdoor as well as indoor service in all foundries of large capacity. This necessarily involves the planning of modern plants with a view to utilizing such a crane in as great a va-

riety of ways as possible. Undoubtedly in many large plants two such cranes operating on one track would find ample employment at a good return on the investment.

The President: You have heard the paper by Mr. True. Is there any discussion? If not, we will proceed to the next paper by Mr. Lewis on "The Uses of Compressed Air."

PROGRESS OF COMPRESSED AIR FOR MECHANICAL PURPOSES.

By J. F. LEWIS.

The subject of compressed air and its uses offers a wide field of investigation. Compressed air is fast becoming an efficient agent for transmission of power. It is not a new power by any means, as we find experiments in compressing air were made more than a century before Christ, and its application to industrial purposes dates back to the last century, but its success as a mechanical power must be credited to the modern engineer of this day. In his hands it has become a powerful, efficient and most interesting agent.

It was first applied by Cubitt and Brunell in 1851-4 to the sinking of bridge caissons. The next engineering work where compressed air was used to any extent successfully, was in boring the Mt. Cenis Tunnel.

In America, it was used by Mr. Walter Shanley in driving the Hoosac Tunnel, from 1868 to 1874, where it proved very successful in the saving in cost of construction and time of completing the work. From this time on, the use of compressed air increased very rapidly for underground work—tunneling and mining.

There is no State in the Union where compressed air has been used to any greater extent than in Michigan, and she can boast of the largest air plants in this country, first adopted in the iron and copper mines of Lake Superior in about 1876, since which time—twenty-one years—there has been mined with compressed air 102,293,757 tons of iron ore, gradually increasing each year from 1,025,129 tons in 1877 to 10,596,559 tons in 1896. An average output of 4,871,131 tons per year. From the year 1870 to 1876 inclusive the output of ore was 6,591,789 tons, or an average of 941,684 tons per year. The number of pounds of copper mined from 1880 to 1897 in Lake Superior is 1,467,313,-

651. From this statement you can get some idea of what compressed air has accomplished in the United States during the last twenty years.

The application of compressed air for mechanical purposes was first started in Paris by Victor Popp, in 1879, consisting of two small compressors and two steam engines of 6 horse power each. This plant was first used to operate pneumatic clocks, and has now increased to 24,000 horse power for mechanical purposes.

In 1892 they compressed 6,887 millions of cubic feet of air. They have a system of 105 miles of compressed air pipe laid under the street, of which 41 miles is used for pneumatic clock service and about 64 miles for the transmission of power, used for the following work:

Lithographic presses, printing, stereotyping, circular saws and others, machines to cut cloth, pumps, grindstones, lathes, rolling presses, refrigerators, ice boxes, coffee grinders, roasters, etc., milling, drilling, planing machines, drying machines, liquid mixing apparatus, sewing machines and others, chopping, grinding machines, special sewing machines, cutting machines, silk looms, machines for electroplating, embroidering machines, tinsmith shears, ventilators, trimming manufacturer, carding, pressing, cleaning machines, combs factory, dynamo motors, machines for physicians, pharmacists and dentists, machines for seltzer, machines for bakery, wood working machinery, sieves, polishing machines, book binding machinery, letter envelope sticking machines, shoe making machinery, motors for aero-heating (hot air), motors for ventilators, motors for dynamos and cold storage rooms, passenger and freight elevators, beer and wine raising, blow pipes.

They are also running street cars by compressed air, known as the Mekarski System.

The applications of compressed air for power purposes are very numerous and new work is found for it continually. There is, of course, great diversity of opinion and practice among engin-

eers as to the means of transmitting power, either by steam, electricity, belt, wire rope or compressed air. Air, perhaps, is the only one that is in every case possible. It would be hard to find an engineering project in which air would not fit the conditions as a power.

Very little progress was made in the use of air for mechanical purposes, except in a very crude way, until the past five years. It is now becoming universal for use in machine shops, boiler shops, railway shops, and, I was going to say foundries, but we find very little work being done in foundries by compressed air. Some few foundries are partially fitted with air for hoisting and cleaning castings.

The Detroit Bridge and Iron Works write, "We are using compressed air for hoists and riveting, but know very little about it in connection with foundry work."

The Russel Wheel & Foundry Co. have recently commenced using compressed air in their construction work, working a pneumatic riveter, which proves most satisfactory.

The Link Belt Machinery Co. use air in their machine shop for air hoists and portable air tools; in their foundry for hoisting only.

The Bass Foundry and Machine Works use air in their boiler shop and in the steam forge department. They believe it could be employed to advantage in their machine and foundry departments.

The Deering Harvester Co. write as follows: "We probably have in use in the neighborhood of 75 to 100 pneumatic hoists for lifting various kinds of work in our factory. We use it in foundry practice, in handling our castings, for raising vertically and horizontally, we use it on testing machines, we use it on machines for pressing castings on to shafts and on many of our pouring cranes in our foundries, as well as numerous other small appliances and we cannot say too much for it. The writer feels like saying that the compressed air problem, or what can be done by compressed air, has not been reached by a great deal, and is in some respects on a line and par with electricity."

The Whiting Foundry Equipment Co. are using compressed air for operating elevator and conveyor for carrying iron, coke, etc., to the foundry charging floor, also for air traveling cranes, one of 4 tons capacity, one of 5 tons, and one of 10 tons, and several vertical hoists in various parts of their plant. They also use it for operating pneumatic chipper, caulker and riveter. They have no doubt of the economy, usefulness and efficiency of compressed air.

Edwin S. Cramp, superintending engineer of the Wm. Cramp & Sons Ship & Engine Building Co., Philadelphia, writes as follows: "We are using the Compressor for the purpose of riveting, drilling and reaming, caulking ship and boiler work, blowing fires for rivet heating, cleaning castings, running punching and shearing machines that were formerly driven by steam, and we feel sure that this extended use of compressed air has resulted in an increased efficiency in the performance of our work."

Railway machine shops, locomotive works and boiler shops have made great headway in the use of compressed air. The A., T. & S. F. Railway installed an air plant 2,000 cubic feet per minute, and are carrying this air through about five miles of pipe around their works. Since this plant was installed, they have purchased eight other Compressors for the different line shops. They report a great saving in cost over the old method by using the Baird Portable Machine Company's tools run with compressed air. With the 10′ reach stationary riveting machine, they drive 2,000 rivets per day of 10 hours with three laborers at a total cost of $4.75 per day. Compare this with hand labor: three men, total $7 per day, and driving only 200 rivets.

The 6′ riveter, combination flange punch and riveting machine, and the bridge and girder riveter, will each average about the same as the 10′ reach riveter.

The truck riveters, one machine operated by two laborers, total $3 per day, drive 3,000 rivets in a day of 10 hours, as compared with hand labor, 3 men at a total of $6 in the same class of work will only drive 175 rivets.

The frame riveter will average about the same as the truck riveter. The stay-bolt breaker will make an average saving of $8 a day. The tank riveter will make an average saving of $10 a day. The mud ring riveter will drive as many rivets as can be handed to it, and will make a saving of from $12 to $15 a day for that class of work. Not only does it make a great saving, but it insures every rivet hole being entirely filled and insures tight work, while with hand driven rivets in mud rings a large per cent of them invariably leak and have to be calked or fullered up. The stay-bolt cutter will do the work of fifteen men. This machine will very easily cut off 1,500 bolts an hour, while when cutting off by the old method of hand hammer and chisel, it goes very slow and is hard work. The rotary tapping and drilling machine will do the work of 4 men. The rotary grinder saves the work of 6 men. Rotary saw for sawing car roofs saves the work of 4 men. Pneumatic hammer will save the work of 3 men. Crown bar bolt machine saves the work of 3 lathes. Rail saw saves the work of 2 men. Rail drill saves the work of 2 men. Device for operating transfer table saves $6 per day. Device for revolving driving wheels for setting valves saves the labor of two men. Device for shearing bolts saves the labor of 2 men. Thirty hoists in shops save the labor of 10 men at $1.50 per day. Device for loading and unloading oil at storehouses saves $6 per day over the old method. Jack for pulling down car draft sills saves $10 per day. Device for fitting up hose couplings over the old method saves $15 per day. Pneumatic painting machines, 1 man does the work of 10 using a hand brush. Machine for tearing down old car roofs saves $8 per day. Jack for raising and lowering freight and passenger cars makes an average saving of 3 men. Drop pit makes an average saving of 3 men. Device for sanding engines saves 1 man. Shifter for switching cars in shop yard saves $50 per week. Device for cleaning coaches saves 10 men. Device for rolling flues makes a saving of 2 men over the old method. Device for white washing, when in use, will do the work of 10 men with a brush."

The Illinois Central Railway Co. installed an air plant in their new shops at Burnside of about 2,000 cubic feet free air per minute. In a letter from Mr. Wm. Renshaw, superintendent of machinery, he says:

"We are at present using compressed air for the following purposes: Elevating sand at engine sand house, elevating oil at oil house, hoisting heavy castings and parts at machine tools, etc., forcing couplings on air hose, operating cylinder boring bar, operating valve facing machine, filling cylinders of hydraulic presses, removing and applying driving tires, testing water pumps after repairs, drilling with motor, tapping with motor, reaming with motor, cleaning boilers, cleaning machinery, punching jacket rivet holes, taking old paint off tin roofs, rolling and beading flues, chipping, cutting, caulking, small bull dozer ,elevating water from deep wells, testing air and driver brakes, elevators in store house, operating letter presses, cutting out stay bolt stubs, jacking up cars and trucks, cleaning interior of coaches, cleaning upholstered work, burning paint off coaches, painting cars, sand blast ends of cars, gasoline heater, cutting off stay bolts, screwing in stay bolts, rivet forges, one blacksmith forge, pressing in driving box brasses, operating flange clamp, swedging flues.

This is the list up to date, but we are finding further use for compressed air every day, and we could not afford to be without it.

I consider it the best means of transmitting power in and about shops: First, on account of the many uses to which it is adapted and the simple appliances needed in connection with its use; Second, with but few exceptions in the above list, steam and electricity could not perform the work without more complicated apparatus, and in a great many instances, air alone is applicable; Third, the appliances used and the pipe line are easily kept in repair by our own shop men; Fourth, there is no element of danger and the apparatus requires no skilled mechanic to handle same and it is safe to use in places where steam or electricity

might be objectionable; Fifth, it can be carried greater distances without loss than steam, and taking into consideration cost of plant, cost of maintenance, skilled help required, etc., it can be produced for less money than electricity.

As regards saving made over old methods, would say, taking into consideration all things, that an average all round saving of 25 to 30 per cent could easily be realized. Take, for instance, the saving effected by use of air hoists alone, which, though hard to figure, will assume large proportions when the amount of labor they take the place of is taken into consideration.

We figure a saving of 60 per cent in burning paint off passenger cars, and 50 per cent in painting freight cars and passenger car trucks."

Mr. J. H. McConnell, superintendent M. P. of the Union Pacific R. R., says: "The many savings through the use of air in the shops of the Union Pacific System aggregate $10,000 per year in labor alone."

Similar statements to the above may be made of the Chicago & Northwestern Ry.; Chicago, Rock Island & Pacific; Michigan Central; Detroit, Lansing & Northern; Grand Trunk; Great Northern; St. Paul & Duluth; Pennsylvania System; Cleveland, Cincinnati, Chicago & St. Louis, and many other railways who are using air extensively.

The question is often asked, "Is compressed air economical?" We answer, Yes, if an economical plant is installed; but a better answer is made by the railways, as no class of mechanics or business men study economy so closely as railway men, and we point to what they are doing with compressed air.

The foundry is the birth-place of all that is grand and beautiful in iron construction. Go to Pullman—visit the Pullman shops and you will see a grand structure that came from the brains of Corliss—an engine of 2,000 horse power, sending power through the extensive shops of the Pullman Company. This engine was built to run the machinery at the Centennial Exposi-

tion in Philadelphia, now 21 years old, but it is to-day seemingly as young as ever. This wonderful machine was born in the sand.

Visit the Michigan Stove Company's works and you will see a combination of beauty and art that will remind one of a flower garden (perhaps I should have said a "Garland" of roses), conceived in the brain of man but born in a foundry. There is no doubt an equal opportunity to economize work in the foundry as in other branches of the industry.

In a letter from an expert consulting engineer on foundry practice and equipment, one who is well up in the business and stands high in his profession, but whose modesty would not permit his name to be used, he writes as follows: It is my opinion and experience that compressed air can be economically used in all processes in the modern foundry. Primarily, I consider it the very best means of conveying the sand into the foundry and distributing it to the various floors of the molders. Secondly, it is an excellent assistant for the molder in cleaning his molds by jets of air under pressure. Thirdly, I consider compressed air heated to the temperature of about 400 degrees and introduced into a closed mold as the very best and most efficient method of drying these molds preparatory to casting, and I believe the future will see great developments in this line. A mold which ordinarily takes from 8 to 10 hours to dry in a core oven with very uncertain results can be positively dried in 20 to 25 minutes by the use of hot compressed air under a pressure of from 3 to 5 lbs., and the result is absolutely certain and perfect. Furthermore, by this method the steam generated in the mold finds its way outward to the sand and vents, the latter in a much more perfect manner than when dried from the outside in an oven. Fourthly, compressed air in its use as a hoisting power in handling flasks, ladles, cores, etc., is now recognized as the best and most efficient method of doing such work. Fifthly, the use of compressed air for cleaning castings by means of pneumatic tools, sand blast apparatus, etc., is also thoroughly recognized and well developed, and the efficiency and economy of this

method for cleaning is beyond question. Sixthly, the use of compressed air in a cupola for melting iron is well known, although the pressures here rarely exceed 10 to 15 ounces. Seventhly, the application of hot compressed air in core ovens for drying cores is another step to be taken in modern foundry practice, as it permits of rapid and sure work without the danger of burning cores, or of leaving same raw, which is constantly present in the core ovens as constructed and used now-a-days.

These heads comprise the particular applications of compressed air in the foundry and also comprise in a general way all the manipulations in the producing of castings, so that it is perfectly safe to state that economy and efficiency dictate the use of compressed air in every step in the production of castings from the raw material to the finished article.

The President: The paper is before you for discussion. Mr. Lewis, I would like to know whether there is an efficient rotary motor in existence adapted to compressed air, so that the motor could be used and attached to the blower in the foundry and to the end of a counter-shaft, which may already exist for operating cranes, the motor to be operated by air from the compressor in the engine room.

Mr. Lewis: Yes, there are three or four rotary engines or motors built, but of course you all know that a rotary motor is not considered economical. But it seems to be about the best thing that can be obtained at present. There are rotary motors that can be attached to any machine by compressed air.

Mr. Putman: I wish to express my appreciation of the paper I have heard. I have used compressed air in the foundry for a considerable number of years. We use it in the foundry department, and the machine shop, and various other departments. We have not gone into the use of it to the extent that we might, or to the extent that we shall. I am speaking now of the Chattanooga Plow Company. We use a large cylinder in the foundry on the floor, where heavy work is done, and it is the best means for handling heavy work that I ever employed. We use it in the

machine shop to raise heavy castings, and move things about the floor. It is beyond all comparison the cheapest way of getting power extant in my estimation, and in our experience we have found it so. Our own laborers put up the pipes around the foundry, and we run the air any way we want. Its utility in the foundry is limited, however. In the drawing of certain kinds of patterns I cannot use it, because I have never been able to overcome the elasticity of the air, which makes a sudden jerk. In making our draw on kettles we draw those patterns with it. We make sugar kettles and heavy iron flasks, and we do it in almost no time, and for such work as that it is very convenient.

Mr. True: In reference to the use of motors with compressed air, we have used a reciprocating engine instead of a motor, and find it gives good results. Any engine you can use with steam you can use with compressed air. If you have a steam crane you can put compressed air in and run it. There is no change in the engines. I have been asked several times how much air was used in the air hoist in the exhibit. That will lift about a ton at 8 pounds pressure, you will see an air hoist of that kind uses little air. A small compressor 6x6 say, delivering 25 to 30 cubic feet per minute will handle 5 or 6 of those hoists, a full stroke every minute or 30 lifting ones for five minutes. But do not let that statement mislead any one. You will find, after once using air in the foundry, that there will be so many uses for it that the compressor will be too small and you should get one three times as large as the one you used first. Regarding the expansion of compressed air in lifting direct acting hoists, that is largely avoided. There may be trouble with some, but not with all. In our own foundry we have applied the air in another way. We have applied it in the form of an engine just driving the drum.

The President: I would mention, in regard to the jumping in raising patterns from a mold, that we used to experience that very much when we had chains. The gentlemen in charge of our foundry changed to steel wire rope, and we have had the ropes in use for 15 years, and would not think of going back to chains. In 30-ton cranes we use ¾-inch rope over the shaft, and you can draw patterns with that, and they come up as steadily as a clock. The next paper will be read by the Secretary. It is by Mr. F. J. Davis, who is absent.

THE VALUE AND USE OF ALUMINUM, MANGANESE AND SILICON IN THE BRASS FOUNDRY.

By F. J. DAVIS.

It is only of late years that aluminum, manganese and silicon have come into use in some of the brass foundries, and in many of them they are still unknown. A greater familiarity with these metals would no doubt prove advantageous and be a source of profit to many of the foundries.

So much has already been written regarding aluminum and aluminum bronze that most of the brass foundries are familiar with the pure metal and one or two of the alloys. Some of them, after two or three failures to obtain a good casting of the bronze have discarded the metal in disgust. Copper, with the addition of from 10 to 11 per cent of aluminum, is undoubtedly the strongest metal known, also one of the most difficult to cast. This difficulty is due to the great shrinkage of the metal and to the fact that a thin film of aluminum oxide forms on the surface of the molten bronze when it is exposed to the air, and shows up in the casting as so much dirt or dross. The shrinkage can be overcome by providing risers or feeding heads for the heavy parts of a casting, but the trouble arising from the oxide is not so easily overcome. If the bronze is poured from the lip of an open crucible the oxide can be seen entering the mold, appearing as a skin on the surface of the stream, and becomes entangled with the metal in the mold, with the result above stated. The presence of the oxide in the casting does not seem to affect the strength of the metal, but when the casting is used for hydraulic work or under steam pressure it will be found to leak wherever the surface shows the oxide or dross. Casting the bronze from a secondary pot set over the mold, drawing the metal from the bottom of same, will prevent the oxide entering the mold to any great extent, and some very large and perfect castings have been made by that method. The hole in the bottom of secondary pot should be about one inch in diameter for large castings, with an

iron plug fitting same perfectly tight. The bronze after being poured from the crucible into secondary pot should be allowed to stand a short time before pulling the plug, which permits the dross in the bronze to come to the surface, only clean metal entering the mold. This plan works perfectly for casting billets and bars for wire drawing and rolling into sheet. Iron molds should be used for this purpose, they should be perfectly clean and heated nearly red hot before the metal is allowed to enter. No wash is necessary or advisable.

A great many castings sold as aluminum bronze are in reality ordinary brass containing perhaps one-half or one per cent of aluminum. While the addition of this amount of aluminum to brass greatly increases the strength, hardness and fluidity of the metal, it is not true aluminum bronze, which is the two part alloy of copper and aluminum, varying in composition from 2 per cent to 11 per cent of aluminum; 11½ per cent of aluminum in copper is about the limit, beyond that the alloy is brittle. The strongest grade of the bronze contains 11 per cent of aluminum, and has a tensile strength of from 80,000 to 90,000 pounds per sq. inch, with a high elastic limit; it is not, however, very ductile, a test bar showing only about 5 per cent elongation in one inch. The presence of silicon in the bronze increases its strength and hardness, but decreases its ductility. An alloy of 3.50 per cent aluminum, 33⅓ per cent zinc and balance copper makes the best and strongest grade of aluminum brass. It has a tensile strength of from 75,000 pounds to 85,000 pounds per square inch and is, of course, considerably cheaper than the 10 per cent aluminum bronze.

SILICON.—As a flux or reducing agent to the oxide of copper that is produced when copper is in a molten condition, silicon is more active in clarifying, refining and strengthening copper, and its alloys of brass or bronze, than aluminum or phosphorous. It has been found upon experiment that the addition of only one-tenth of 1 per cent of silicon to melted copper before pouring will make the bath more fluid, removes the oxide of copper, makes the castings clean and solid and entirely free from blow-holes.

By the use of silicon in this manner, difficult and complicated castings can be made from pure lake or electrolytic copper. Where difficulty is experienced in obtaining solid castings from some of the brass and tin bronze mixtures, the addition of a very small amount of silicon will remedy the difficulty. In the two-part alloys of silicon and copper, 1 per cent of silicon will go as far as 2 per cent of aluminum in hardening and stiffening copper, that is, an alloy of 95 per cent copper and 5 per cent silicon known as silicon bronze is as hard and stiff as an alloy of 90 per cent copper and 10 per cent aluminum, and while perhaps silicon bronze will not resist corrosion as well as aluminum bronze, it is a much better casting metal. It is also valuable for castings subjected to steam or water pressure, as it is a very dense and close-grained metal. The 5 per cent silicon bronze has also been used very successfully for casting large vats in which a solution of caustic soda is used, the metal resisting the action of the caustic soda much better than any of several other metals tested. The most useful of the silicon bronzes are the 3 per cent (97 per cent copper, 3 per cent silicon) and the 5 per cent (95 per cent copper, 5 per cent silicon), although the hardness and strength of the alloy can be increased or decreased at will by increasing or decreasing the percentage of contained silicon. A 3 per cent silicon bronze has a tensile strength, in a casting, of about 55,000 pounds per square inch and from 50 to 60 per cent ductility; it is valuable where a tough and ductile metal is required.

The 5 per cent silicon bronze has a tensile strength of about 75,000 pounds per square inch and about 8 per cent ductility, making a very strong and tough metal. More than 5 or 5½ per cent of silicon in copper makes a brittle alloy. In using silicon, either as a flux or for making silicon bronze, the rich alloy of silicon and copper which is now on the market should be used. It should be free from iron and other metals if the best results are to be obtained. Ferro silicon is not suitable for use in copper or bronze mixtures.

MANGANESE BRONZE.—In much of the manganese bronze used by foundrymen in this country the manganese is

added in the shape of ferro manganese, which necessarily introduces considerable iron into the bronze. There is no doubt that this iron is injurious, and that the bronze so made is much more readily corroded and not nearly so strong, tough and ductile as bronze that does not contain iron. A rich alloy of manganese and copper, containing no iron or other impurities, is now on the market, and by using this alloy a very pure manganese bronze of any desired grade can be produced. One of the best and cheapest bronzes can be made after the following formula:

Copper	53.00 per cent.
Zinc	42.00 per cent.
Manganese	3.75 per cent.
Aluminum	1.25 per cent.

This makes a very strong, tough metal, suitable for propeller wheels, gears and pinions, mining machinery, etc. As the bronze contains no iron, a much greater quantity of zinc can be added than when ferro manganese is used, without danger of making the metal brittle. In the above mixture it is quite important that the aluminum be present, as without it difficulty will be experienced in obtaining solid castings; in fact it is necessary to add a small amount of aluminum to all the manganese bronzes, as without it they will not cast solid, but no trouble is experienced in obtaining solid castings when a small amount is used. Manganese bronze in the form of sheets is used quite extensively for mining screens, as the acid mine waters have no action on it. For rolling into sheets, a mixture containing more copper and manganese and less zinc is used.

A substitute for german silver can be made by the use of manganese, the different metals and their proportions being as follows:

Copper	67.25 per cent.
Manganese	18.50 per cent.
Zinc	13.00 per cent.
Aluminum	1.25 per cent.

The color of this metal is very good, resembling german silver closely. It is fully as strong as the best german silver and has superior casting qualities, which will be appreciated by foundrymen who have experienced some of the difficulties in casting german silver. It does not corrode as readily as either german or nickel silver. A test of the electrical resistance of this metal shows its resistance to be nearly four times greater than that of german silver, and is therefore a matter of importance where a metal of very high electrical resistance is required.

REPORT OF COMMITTEE ON NOMINATIONS.

The President: The next business in order is the report of the Committee on Nominations, Mr. Russel chairman.

Mr. Russel: Your committee is pleased to report a list of names which it thinks will be a very satisfactory report to the convention. In casting about more particularly for the Executive Board we found that Mr. Schumann had expressed much unwillingness to accept the nomination for President for the ensuing year. Finding him emphatic, we decided to look about for other timber, but in going over the question very carefully, and I can assure you it has been gone over most carefully, we came to the conclusion that it was best to see him again and ask him if it would not be possible to accept the nomination. This morning, after considerable persuasion, he allowed his name to be again presented. I therefore make this report. (Applause.)

Your Committee on Nominations recommend the following gentlemen as the nominees of the convention for the ensuing year:

President—Francis Schumann, Philadelphia, Pa.

Secretary—John A. Penton, Detroit.

Treasurer—Howard Evans, Philadelphia.

Vice-President for New England—W. E. Sessions, Bristol, Conn.

Vice-President for Middle States—J. M. Frank, Pittsburg, Pa.

Vice-President for Southern States—E. H. Putman, Chattanooga, Tenn.

Vice-President for Central States—C. S. Bell, Hillsboro, Ohio.

Vice-President for Northwestern States—C. J. Wolff, Chicago.

Vice-President for Southwestern States—W. S. Mosher, Dallas, Texas.

Vice-President for Pacific States—To be filled by Executive Board.

Vice-President for Canada—Joseph Best, Montreal.

Respectfully submitted,

J. R. RUSSEL, Chairman.

I may say the Secretary and Treasurer absolutely refused to accept nomination at first, but finally consented.

The President: You have heard the report, what is your pleasure?

Mr. Bell: I believe, under the constitution, the election will be by ballot, and I move that we suspend the rules ordering a ballot in order that we may elect the gentlemen named by acclamation.

Motion duly seconded, put, and carried unanimously.

Mr. Bell: It is suggested that this is bad politics on my part, as I am a candidate, but having more interest for the other members, I now move that the gentlemen named by the committee be elected by acclamation.

Motion carried unanimously.

The President: I declare the motion carried, and the gentlemen so elected. As being the first on the list, I want to thank the gentlemen here for the honor conferred on me and for the confidence reposed in me. I did not intend to accept the position, and came here with that intention, emphatically. But for the sake of carrying the Association over the transitory period as suggested by some of the gentlemen, I have changed my intentions. I merely want to say that the foundry industry is undoubtedly entering upon an era of great changes. Great evolutions are taking place in our business, and it is by an organization like this that knowledge necessary to attain this object can only be obtained. I hope all the members will seriously and enthusiastically do what they can for the prestige of the Association. Gentlemen, I thank you once more for the honor conferred on me.

Secretary Penton: In electing me for Secretary, I might say that it is the people who elected me who have the fun, not me. This position requires more than you imagine, and I have given it more than I ever thought it would require, but things have got in such a way that, owing to my lack of ability, there is no getting out of it.

It would not do for me at this time, perhaps, to insist upon being excused. I owe the foundry business and those interested in it much.

The gentlemen who compose ths convention are and have been my friends, and greatly as I might desire it, I could not afford to neglect any call they might make upon me.

It is a serious responsibility that you put upon me, and I know that during the coming year the foundrymen of America will be watching the progress of the Association, and the degree of success that may attend our united efforts must depend largely upon the Secretary's work.

However, it is not necessary to promise that I will do my best.

I shall endeavor during the coming year to place things in such a position that there will be about 40 candidates in the field for the office at the next convention.

Mr. Bell: I have a remark to make, referring to the nomination that has been made here for President, Vice-Presidents, and Executive Committee. It is well known to all of you that Mr. Schumann absolutely refused to have his name mentioned for the position of President again, and with all due deference to the gentlemen who were named, a number of us felt the importance of the step we were about to take as something which could not be overestimated. We are in a very peculiar position, it means that for the coming year the success or the failure of the Association depends on our united efforts. I believe we all realize that. We came here last year, and this, largely in an experimental way. We are satisfied as far as it has gone, but after awhile the fever or excitement of the experimental part passes off, and if you have not got those in office in whom you have the utmost confidence, and who have ability and character, the thing will die out and we are finished, and I so expressed it to Mr. Schumann this morning. Presenting it to him on the ground that the life and vitality of this Association made it necessary to put somebody in the position of President in whom we all had confidence, and who had the ability to carry the Association forward, on this ground, and for this reason only, Mr. Schumann has consented to continue his

office. I want every member of the Association to make himself a committee of one to see that the Association is a final success.

Mr. Evans: I have very little to say. I would like to make an announcement that last night there was a meeting of the Plumbago Club and I believe it was their last meeting. They bought 500 cords of wood and donated it to the poor of Detroit.

Mr. Best: I wish to return thanks to the Association for again conferring on me the honor of the position of Vice-President of Canada. Last year I had the pleasure of being with you in Philadelphia, and to my great surprise to hear on the morning after the election that I was elected Vice-President for Canada. It is highly appreciated by me and by the firm I have the honor to represent. I came here this time and have the honor of being re-elected. As there have been gentlemen who are more competent to fill the position, I am more honored. During the past year I had the pleasure of meeting several Americans in the City of Montreal, and I have been able to introduce them to business firms and they have been enabled to do business to the mutual benefit of both parties. I trust in the future to be of more benefit than in the past. I would like to say one word in praise of our friend Mr. Penton. I think the success of the Association has been largely due to his exertions. He has worked hard during the past year, and I think the great success of the Association and this convention is largely due to his exertions. We have had a grand time in Detroit.

Mr. Penton: Mr. Best's remarks are well taken, but he nearly spoiled all he said by diverting slightly from the truth. When he spoke of my connection with the entertainment in Detroit, I mean. Mr. Russel is the man to whom everything is due. If it had not been for him you would have been pretty hard up for many things.

The President: I have been loaded up with suggestions from various members, and I want in simple language to express the thanks of the Association to the City of Detroit for the most hospitable entertainment of the members of this Association. There-

fore I suggest that a standing vote be tendered the local committee of which Mr. Russel is chairman.

Motion duly seconded and a rising vote taken.

Mr. Russel: I would say in passing along the vote, Mr. President, following Mr. Penton's remarks, that the work was done by the local committee, and the work has been a pleasure. I am glad the members of the Association, in accepting the invitation to come here to Detroit have found the visit one of pleasure. It has been a pleasure to us to have been able to entertain you. I would suggest that you incorporate in your vote some terms of satisfaction to the telegraph and telephone companies for the long distance service given in this hall.

Mr. Sessions: I want to thank you for the honor conferred on me in electing me Vice-President for the New England States, and also to express my thanks to the people of Detroit for the entertainment given us here. I feel indebted also to the gentlemen who have prepared papers. I have enjoyed the convention very much, and think we shall go home refreshed to fight out the battle of life and to carry forward our businesses. These have been times when men's wills have been tried and when everything has been tried. Now we are going along and I think we have quite a new inspiration from this meeting in Detroit. I notice in the "Foundry" it was said that preparations had been made for everything except the weather, and it seems to me the Detroit people have been able to provide as good weather as we could wish.

Mr. Frank: I entirely appreciate the honor conferred on me in electing me Vice-President for so important a district as the Middle District, and I assure you I will do anything in my power for the Association. I believe the Association is born for good, and I believe its success can be assured, and that those who remained away scarcely appreciate what they have missed. I believe the next issue of our transactions will open their eyes to the great importance of this meeting. I thank you once again for the honor conferred on me.

Mr. Wolff: Mr. President and members of the Association. It was entirely unexpected by me that my name would be put up for office as one of the Vice-Presidents. I am very green in the duties of such a position, but anything I can do in my territory to further the interests of this Association I am sure I shall be glad to do. I think one thing has been overlooked, at least I did not hear any mention of it, and it is that the Entertainment Committee and the Committee of Detroit deserve special thanks for the nice way in which they have treated the ladies of the visiting members. The ladies have been entertained almost every minute they have been in Detroit. I again thank you for the confidence reposed in me.

Mr. Putnam: I shall have to begin my speech as a German friend of mine did. He said: "Mr. Chairman, I was not much used to making public speeches, but at the same time I would like to make a few remarks. There was a man in the old country, a crutch maker, who was so rich he knew not what became of all his money. No, I was not much used to making public speeches, but at the same time I would like to make a few remarks. There was a man in the old country who was a crutch maker, and he was so rich he didn't know what to do with all his money." That is as far as he got. I do not know that I am any better. I am so heartily and so sincerely interested in this Foundrymen's organization, and I have so much hope and confidence in the outcome of it. I want to express myself a little further. I am not so rich that I do not know what to do with all my money, but I feel a great deal richer at this moment than when I came here. I have learned a great deal more than I care to teach. In conversing with the people here I have learned from everybody, I thought I was pretty well up in iron founding. I have for 38 years been hunting everything in it, but I have picked up a good deal since I came to this convention, and I hope to come to the next one. A man who is a foreman as I am and comes here and gets what he can brings himself up to a quality near that of his employer, is a more valuable man to that employer, and is so recognized by him. I have, as editor of the Foundry Department

of the "Tradesman," advocated organizations, and I am looking forward to a local association in the South this year. I have given a good deal of space to advertising this convention, and I shall in the future do all in my power to make the Association a grand success. I thank you for the honor conferred on me.

The President: Is there any further business? If not, a motion to adjourn is in order.

Mr. Yagle: I would move that the convention adjourn sine die, to meet again at the call of the Executive Board at the place stated by them.

Motion duly seconded, put and carried.

ATTENDANCE.

The following attended the convention:

Francis Schumann, Tacony Iron and Metal Co., Philadelphia.
Howard Evans, J. W. Paxson Co., Philadelphia.
Wm. Yagle, Wm. Yagle & Son, Pittsburg, Pa.
A. Sulzer, Sulzer Bros., Winterthur, Switzerland.
S. T. Johnston, Whiting Foundry Equipment Co., Chicago.
John Hill, S. Obermayer Co., Cincinnati, Ohio.
Oliver Phelps, Michigan Peninsular Car Co., Detroit.
Roy Wise, Keystone Coal and Coke Co., Pittsburg, Pa.
J. R. Russel, Russel Wheel and Foundry Co., Detroit.
J. Springer, Michigan Brass and Iron Co., Detroit.
Frank L. Deane, Michigan Brass and Iron Co., Detroit.
John Meighan, Dawson Bros. & Meighan, Pittsburg, Pa.
John A. Penton, "The Foundry," Detroit.
J. M. Ryan, McConway & Torley, Pittsburg, Pa.
R. H. Frees, Walkerville Malleable Iron Co., Walkerville, Ont.
G. H. Carver, Piano Mfg. Co., West Pullman, Ill.
H. S. Vroman, Garden City Sand Co., Chicago.
B. D. Northrup, Washington, Pa.
T. H. Simpson, Michigan Malleable Iron Co., Detroit.
W. E. Fitch, Peerless Mfg. Co., St. Louis, Mo.
S. D. Sleeth, Westinghouse Air Brake Co., Pittsburg, Pa.
S. B. Robinson, Robinson Machine Co, Monongahela, Pa.
John A. Logan, Pittsburg, Pa.
Henry Hansen, "The Foundry," Detroit.
Wm. Stridiron, Berry Bros. Mfg. Co., Detroit.
M. J. Bourke, Wisconsin Malleable Iron Co., Ashland, Wis.
Geo. Fuller, Monarch Brake Beam Co., St. Paul, Minn.
D. F. O'Brien, A. P. Smith Co., Newark, N. J.
G. F. Cocker, Buchel Brush Co., New Orleans, La.
T. E. Malone, The J. S. McCormick Co., Pittsburg, Pa.
W. M. Wilson, The J. S. McCormick Co., Pittsburg, Pa.
C. W. Jones, Rosedale Foundry Co., Allegheny, Pa.

Wm. Ferguson, Gates Iron Works, Chicago.

John Smith, Jr., S. F. Hodge & Co., Detroit.

C. T. Holbrook, Davis Coal & Coke Co., Philadelphia.

A. Cochrane, Michigan Malleable Iron Co., Detroit.

John S. Graham, Baldwin & Graham, Pittsburg, Pa.

Sam. R. Baldwin, Baldwin & Graham, New Castle, Pa.

P. W. Zieg, Baldwin & Graham, Pittsburg.

F. A. Goodrich, F. A. Goodrich & Co., 926 Chamber of Commerce, Detroit.

Wm. Gerhauser, Superior Charcoal Iron Co., 66 Newberry Building, Detroit.

J. J. Burgen, Lane Mfg. Co., Montpelier, Vt.

F. W. King, Michigan Stove Co., Detroit.

H. M. Leland, Leland & Faulconer Mfg. Co., Detroit.

R. Viall, Brown & Sharpe Mfg. Co., Providence, R. I.

E. J. Lyon, Brown & Sharpe Mfg. Co., Providence, R. I.

Chas. T. Wilson, Wm. Sellers & Co., Philadelphia.

William Scott, Roe Stephens Mfg. Co., Detroit.

W. J. Keep, Michigan Stove Co., Detroit.

L. N. Allen, Standard Foundry & Mfg. Co., Cleveland, Ohio.

Jesse R. Oller, Geiser Mfg. Co., Waynesboro, Pa.

Jas. P. Lowell, Geiser Mfg. Co., Waynesboro, Pa.

Bennard F. Oller, Geiser Mfg. Co., Waynesboro, Pa.

L. D. Gilbert, Frick Company, Waynesboro, Pa.

J. S. Wilbraham, Wilbraham Baker Blower Co., Philadelphia, Pa.

Geo. F. Stibgen, Marietta Casting Co., Marietta, Pa.

John M. Warner, Rogers, Brown & Warner, Philadelphia.

F. M. Bookwalter, James Leffel & Co., Springfield, Ohio.

S. Groves, Taylor, Wilson & Co., Pittsburg.

J. H. Pepper, "Iron Age," Philadelphia.

Thos. Devlin, Thos. Devlin & Co., Philadelphia.

John Rohland, Coxie Iron Mfg. Co., Drifton, Pa.

Twining Campbell, Patterson, N. J.

James Eastwood, Benj. Eastwood, Patterson, N. J.

W. E. Sherlock, Novelty Iron Co., Canton, O.

J. E. Fisher, National Transit Co., Oil City, Pa.

F. W. Gibby, Mechanics' Iron Foundry Co., Boston, Mass.

Alex. Jarecki, Jarecki Mfg. Co., Erie, Pa.

James Gilbert, McKinnon Mfg. Co., Bay City, Mich.

H. F. Frohman, S. Obermayer Co., Chicago.

J. K. Pollock, Rogers, Brown & Co., Cincinnati.

Geo. H. Lincoln, Geo. H. Lincoln & Co., South Boston.

J. F. Lanigan, Davis Foundry Co., Lawrence, Mass.

F. J. Best, Warden King & Son, Montreal, Quebec.

Frank H. Chamberlin, Cleveland Facing Mills Co., Cleveland.

A. L. Carlton, Pratt & Whitney Co., Hartford, Ct.

J. E. Orme, Washington Foundry, St. Paul, Minn.

E. P. Osgood, Osgood & Hart, Charlestown, Mass.

B. T. Bacon, Pickands, Brown & Co., Chicago.

W. W. Hearne, Matthew Addy & Co., Cincinnati.

F. A. Flather, Lowell Machine Shop, Lowell, Mass.

Geo. B. Smith, Lowell Machine Shop, Lowell, Mass.

James T. Winn, Ward & Nash, Chicago.

Thos. Wathey, Walker Mfg. Co., Cleveland.

John F. Brayer, Co-operative Foundry Co., Rochester, N. Y.

Frank N. Brayer, Co-operative Foundry Co., Rochester, N. Y.

J. E. Radford, American Tool & Machine Co., Boston.

J. K. Hanes, "Iron Age," Chicago.

J. F. Mills, Abenroth Bros., Port Chester, N. Y.

S. H. Merrick, S. Obermayer Co., Cincinnati, O.

Geo. McG. Morris, John B. Morris Foundry Co., Cincinnati, O.

Wm. H. Carpenter, A. Carpenter & Sons' Fdy. Co., Providence.

E. Moliter, Detroit.

D. Moliter, Detroit.

Geo. B. Buckingham, Arcade Malleable Iron Co., Worcester, Mass.

Geo. H. Gibby, Condor Iron Fdy. Co., East Boston, Mass.

Edward Maher, Maher & Flockhart, Newark, N. J.

L. S. Brown, Springfield Facing Co., Springfield, Mass.

T. P. Kelly, T. P. Kelly & Co., New York.
Daniel Gallagher, T. P. Kelly & Co., New York.
Isaac M. Frank, Frank Kneeland Machine Co., Pittsburg, Pa.
Wm. Metcalf, Jr., Frank Kneeland Machine Co., Pittsburg, Pa.
Chris J. Wolff, L. Wolff Mfg. Co., Chicago.
W. H. Pfahler, Abram Cox Stove Co., Philadelphia, Pa.
Abram C. Mott, Abram Cox Stove Co., Philadelphia, Pa.
Thos. J. Hogan, Sec. Nat. Stove Manufacturers' Association.
F. M. Lyon, Supt. Burlington Route Foundry, Aurora, Ill.
D. E. Trahem, Rockford, Ill.
Geo. H. Lyon, C., B. & Q. Foundry, Aurora, Ill.
Lee Burt, Pres. Union Iron Co., Detroit, Mich.
Geo. W. Cope, Cope Pattern Works, Detroit.
Fred H. Strong, Whitehouse & Strong, Kewanee, Ill.
L. A. Crandall, Crandall Fdy. Fitting Co., Detroit, Mich.
H. H. Miller, Whitehead Bros., Providence, R. I.
V. L. Whitehead, Whitehead Bros., Buffalo, N. Y.
Walter Rutson, Cleveland Foundry Co., Cleveland, O.
M. F. Martin, Cleveland Foundry Co., Cleveland, O.
E. H. Mumford, The Tabor Mfg. Co., Elizabeth, N. J.
R. M. Dyer, Aermotor Co., Chicago.
W. C. Swift, H. E. Pridmore, Chicago.
R. E. Turnbull, H. E. Pridmore, Chicago.
T. F. A. Lutterman, Toledo, Ohio
F. B. Gaylord, Gaylord Iron Co., Detroit.
James Inglis, American Blower Co., Detroit.
H. G. Lobenstine, Crescent Brass & Iron Works, Detroit.
T. J. Hogan, Jr., Chicago.
W. F. Greene, Troy, N. Y.
G. A. True, Whiting Foundry Equipment Co., Chicago.
Capt. C. K. Brandon, Detroit, Mich.
E. A. Wales, Griffin Wheel Co., Detroit.
John O. Campbell, Art Stove Co., Detroit.
N. McMillan, Art Stove Co., Detroit.
B. Gomersall, Leland & Faulconer Mfg. Co., Detroit.

John A. Walker, Jos. Dixon Crucible Co., Jersey City, N. J.

C. S. Bell, The C. S. Bell Co., Hillsboro, O.

J. W. Weldon, Art Stove Co., Detroit.

E. A. Sumner, American Radiator Co., Detroit.

Henry J. Hartman, Grand Rapids, Mich.

Lyne Adrianse, Butterworth & Lowe, Grand Rapids, Mich.

Geo. H. Barbour, Michigan Stove Co., Detroit.

J. J. Hoffmann, F. B. Stevens, Detroit.

F. B. Stevens, Detroit.

Theo. P. Byram, Byram & Co., Detroit.

E. J. Woodison, F. B. Stevens, Detroit.

Henry Gleason, New York.

T. S. Kingsley, Eugene Munsell & Co., New York.

J. G. Johnston, Mich. Pen. Car Co., Detroit.

H. J. McCartney, American Telephone & Telegraph Co., New York.

D. H. Roberts, McRae & Roberts Co., Detroit.

B. F. Carpenter, F. B. Stevens, Detroit.

S. A. Whitehouse, Whitehouse & Strong, Kewanee, Ill.

J. D. Smith, J. D. Smith Foundry Supply Co., Cincinnati.

W. T. White, J. D. Smith Foundry Supply Co., Cincinnati.

Geo Gane, Washburn Crosby Co., Minneapolis.

Jas. A. Beckett, Walter A. Wood Co., Hoosick Falls, N. Y.

S. H. Morris, Detroit Furnace & Heater Co., Detroit.

Wm. H. Frost, Smith's Falls Malleable Iron Co., Smith's Falls, Ont.

John Trix, American Injector Co., Detroit.

W. H. Fernwood, Art Stove Co., Detroit.

W. Lemon, Mich. Mall. Iron Co., Detroit.

David Brennan, Michigan Mall. Iron Co., Detroit.

Arthur T. Gallery, T. M. Bissell Plow Co., Eaton Rapids, Mich.

R. C. Faulconer, Leland & Faulconer Mfg. Co., Detroit.

M. A. McPherson, Frontier Iron Works, Detroit.

E. S. Bryant, Frontier Iron Works, Detroit.

N. Woods, Gaylord Iron Co., Detroit.

Chas. J. Hodge, Lake Superior Iron Works, Houghton, Mich.

E. E. Mains, Detroit Steel & Spring Co., Detroit.

John T. Thompson, Advance Foundry, Battle Creek, Mich.

Robert Smith, Dry Dock Engine Works, Detroit.

J. R. Homer, Gallion Foundry Co., Gallion, Ohio.

W. G. Henderson, Henderson & Trago, Cleveland.

D. C. Trago, Henderson & Trago, Cleveland.

J. C. Reed, Keystone Coal & Coke Co., Pittsburg.

Edward Pitcavin, Keystone Coal & Coke Co., Pittsburg.

E. M. Gross, Keystone Coal & Coke Co., Pittsburg.

N. P. Hyndman, Washington Coal & Coke Co., Pittsburg.

W. M. Singer, Keystone Coal & Coke Co., Pittsburg.

W. W. Sly, Fanner Mfg. Co., Cleveland.

A. G. Matson, Dry Dock Engine Co., Detroit.

A. G. Sutherland, Kansas City Wire & Iron Works, Kansas City, Mo.

Hopkins Williams, Fanner Mfg. Co., Cleveland.

E. O. Wheeler, Pratt & Letchworth, Buffalo.

O. P. Letchworth, Pratt & Letchworth, Buffalo.

W. W. Cheney, S. Cheney & Son, Manlius, N. Y.

E. A. Beach, Beach & Co., Medina, N. Y.

M. J. Powers, The Albany Facing Mill Co., Albany, N. Y.

S. S. Knight, Addyston Pipe & Steel Co., Addyston, O.

E. H. Putnam, "The Tradesman," Chattanooga, Tenn.

E. N. Foss, B. F. Sturtevant & Co., Boston.

J. G. Sadlier, Springfield Foundry Co., Springfield, O.

U. N. Kanavel, E. M. Ayers, Zanesville, O.

Geo. W. Cope, "The Iron Age," Chicago.

Daniel Stern, "The American Artisan," Chicago.

Sidney P. Johnston, "The American Artisan," Chicago.

Chas. E. Brackitt, "The American Artisan," Chicago.

A. H. Swanson, Whitney Iron Works Co., New Orleans, Ia.

Henry Keep, Detroit.

L. R. Rogers, Nickel Plate Stove Polish Co., Chicago.

W. E. Sessions, Sessions Foundry Co., Bristol, Conn.

D. T. Evans, The Mt. Carbon Co., Ltd., Powellton, W. Va.

D. T. Roots, P. H. & F. M. Roots Co., Connersville, Ind.
J. M. Skulley, Smith & Anthony Co., Wakefield, Mass.
Arthur W. Walker, Walker & Pratt Mfg. Co., Boston, Mass.
Bartlett M. Shaw, Walker & Pratt Mfg. Co., Boston, Mass.
Thurlow Titus, Walker & Pratt Mfg. Co., Watertown, Mass.
C. J. Langdon, Fulton Foundry Co., Cleveland, O.
W. E. Walker, Weir Stove Co., Taunton, Mass.
M. M. Whipple, American Tool & Machine Co., Boston, Mass.
H. W. Cheney, Leland & Faulconer Mfg. Co., Detroit.
M. Z. Fox, F. B. Stevens, Detroit.
W. F. Hyde, Brand Stove Co., Milwaukee, Wis.
J. W. Moller, Burrs Damascus Tool Works, Detroit.
H. E. Culverwell, Burrs Damascus Tool Works, Detroit.
Jas. H. Burr, Burrs Damascus Tool Works, Detroit.
Chas. Clarage, Thos. Clarage & Son, Kalamazoo, Mich.
William H. Switzer, Superior Foundry Co., Little Falls, N. Y.
A. D. Hasbrouck, The Johnson Co., Johnstown, Pa.
John R. Reed, H. B. Smith Co., Westfield, Mass.
Wilfred Leland, Leland & Faulconer Mfg. Co., Detroit.
A. A. Parker, A. A. Parker & Bros., Detroit.
B. W. Parker, A. A. Parker & Bros., Detroit.
D. W. Gordon, Ohio Sand Co., Conneaut, O.
Henry Cribben, Cribben, Sexton & Co., Chicago.
C. S. Reynolds, C. S. Reynolds & Co., Columbus, O.
Ed. A. Sumner, Jr., American Radiator Co., Detroit.
A. E. Doak, Whitehead Bros. Co., Buffalo.
J. L. Gobeille, Gobeille Pattern Co., Cleveland.
Theo. Miller, Detroit.
W. H. Palmer, Globe Elect. Co., Sharon, Penn.
J. D. Groff, Globe Elect. Co., Sharon, Pa.
Thos. Doherty, Doherty Mfg. Co., Sarnia, Ont.
C. D. Miller, Wilmot & Hobbs Mfg. Co., Bridgeport, Conn.
C. S. Bacon, F. A. Goodrich & Co., Detroit.
E. T. Paterson, Chicago.
Edwin D. Metcalf, D. M. Osborne & Co., Auburn, N. Y.

W. Field, Coffin & Wood, Chicago.
A. I. Findley, "Iron Trade Review," Cleveland, O.
Thos. D. West, T. D. West Foundry Co., Sharpsville, Pa.
Chas. Sellbach, Forest City Foundry & Mfg. Co., Cleveland, O.
T. H. Gartland, Gartland Foundry Co., Cleveland, O.
J. W. Gardam, Wm. Gardam & Son, New York.
S. P. Bacon, F. A. Goodrich & Co., Cincinnati, O.
C. J. Stuart, Co-operative Foundry Co., Detroit.
Jos. F. Disney, Mich. Penn. Car Co., Detroit.
Henry E. Pridmore, Chicago.
P. R. Evans, Mich.-Penn. Car Co., Detroit.
John Kane, Kerr Murray Mfg. Co., Fort Wayne, Ind.
G L. Hackins, Kerr Murray Mfg. Co., Fort Wayne, Ind.
E. Dennis, Dennis Machine Co., Jackson, Mich.
E. K. Rundle, Rundle-Spencer Mfg. Co., Milwaukee, Wis.
J. N. Matlock, A. A. Griffing Iron Co., Jersey City, N. Y.
Felix Kahn, F. L. Kahn & Bro., Hamilton, O.
Jas. F. Lewis, Rand Drill Co., Chicago.
Joseph Koons, Lehigh Valley R. R. Co., Weatherly, Pa.
A. T. Matthews, Matthews Mfg. Co., Worchester, Mass.
W. J. McBride, Mich.-Penn. Car Co., Detroit.
D. Symington, Frontier Iron Works, Detroit.
Howard M. Hooker, Rogers, Brown & Warner, Pittsburg.
Henry W. Wendt, Buffalo Forge Co., Buffalo.
Geo. H. Pratt, E. Bement & Sons, Lansing.
Jeremiah Dwyer, Michigan Stove Co., Detroit.

THOSE WHO MADE THE ENTERTAINMENT POSSIBLE.

The thanks of the convention are due the following firms and individuals who contributed to the entertainment fund:

Matthew Addy & Co., Cincinnati.
Cleveland Facing Mills Co., Cleveland.
Ward & Nash, Chicago.
Gobeille Pattern Co., Cleveland.
H. E. Pridmore, Chicago.
J. W. Paxson Co., Philadelphia.

Davis Coal & Coke Co., Piedmont, W. Va.
Springfield Facing Co., Springfield, Mass.
Aermotor Co., Chicago.
Dayton Coal & Iron Co., Cincinnati.
Washington Coal & Coke Co., Pittsburg.
T. P. Kelly & Co., New York.
Rogers, Brown & Warner, Philadelphia.
Whiting Foundry Equipment Co., Chicago.
J. S. McCormick Co., Pittsburg.
Tabor Mfg. Co., Elizabeth, N. J.
McCullough-Dalzell Co., Pittsburg.
Pedrick & Ayer Co., Philadelphia.
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Brown & Sharpe Mfg. Co., Providence, R. I.
M. A. Hanna & Co., Cleveland.
Rogers, Brown & Co., Cincinnati.
Spearman Iron Co., Sharpsville, Pa.
Syracuse Chilled Plow Co., Syracuse, N. Y.
Pickands, Mather & Co., Cleveland.
E. M. Ayers, Zanesville, Ohio.
Clinton Iron & Steel Co., New York.
Perkins & Co., Sharpsville, Pa.
Stewart Iron Co., Cleveland.
American Glutrose Works, Philadelphia.
Wilbraham-Baker Blower Co., Philadelphia.
S. Obermayer Co., Cincinnati.
Wm. Sellers & Co., Philadelphia.
Barnum-Richardson Co., Lime Rock, Ct.
Walkerville Malleable Iron Co., Walkerville, Ont.
E. M. Ayers, Zanesville, O.
Ohio Iron & Steel Co., Lowellville, O.
Illinois Steel Co., Chicago.
Gould & Eberhardt, Newark, N. J.
Brown-Bonnell Iron Co., Youngstown, O.
William R. Thomas, New York.
N. S. Bartlett & Co., Boston.
J. D. Smith Foundry Supply Co., Cincinnati.

Buchel Machine Works, New Orleans.
Damhoff & Joyce Iron Co., Cincinnati.
Hugh W. Adams & Co., New York.
Colbert Iron Co., Sheffield, Ala.
Whitehead Bros. Co., New York.
Ingersoll-Sergeant Drill Co., New York.
Crozer Iron Co., Upland, Pa.
Pickands, Brown & Co., "Rookery," Chicago.
Byram & Co., Detroit.
C. C. Wormer Machinery Co., Detroit.
American Radiator Co., Detroit.
American Blower Co., Detroit.
Art Stove Co., Detroit.
Buick & Sherwood Mfg. Co., Detroit.
Dry Dock Engine Works, Detroit.
Detroit Stove Works, Detroit.
Detroit Steel & Spring Co., Detroit.
Frontier Iron Works, Detroit.
Fulton Iron & Engine Works, Detroit.
Griffin Wheel Co., Detroit.
A. Harvey's Sons Mfg. Co., Detroit.
Samuel F. Hodge & Co., Detroit.
Jenks & Muir Mfg. Co., Detroit.
Leland & Faulconer Mfg. Co., Detroit.
Michigan Malleable Iron Co., Detroit.
Michigan Peninsular Car Co., Detroit.
Murphy Iron Works, Detroit.
Russel Wheel & Foundry Co., Detroit.
Roe Stephens Mfg. Co., Detroit.
J. T. Wing & Co., Detroit.
Detroit Emery Wheel Co., Detroit.
George W. Cope, Detroit.
F. A. Goodrich & Co., Detroit.
C. A. Sterling & Co., Detroit.
A. A. Parker & Bro., Detroit.
F. B. Stevens, Detroit.

Carnegie Steel Co., Detroit.
Superior Charcoal Iron Co., Detroit.
Detroit, Belle Isle & Windsor Ferry Co., Detroit.
H. D. Edwards & Co., Detroit.
Buhl Sons Co., Detroit.
Gaylord Iron Co., Detroit.
Co-operative Foundry Co., Detroit.
R. L. Ginsburg & Sons, Detroit.

THE PHILADELPHIA FOUNDRYMEN'S ASSOCIATION.

The sixty-eighth monthly meeting of the Foundrymen's Association was held at the Manufacturers' Club in Philadelphia on May 7. President P. D. Wanner occupied the chair, and there was a good attendance of members.

The Executive Committee's report was read by Secretary Evans as follows:

"Your committee would report that there has been very little or no change in business during the last month. The great majority of foundries are running on short time and at low prices. We have just received a letter from the Pennsylvania Railroad shop at Altoona in which they say they have never been so dull as they are at the present time. We are glad to say, however, there are some few foundries who are busier than they have been for a long time, notably Wm. Cramp & Sons Ship and Engine Building Co., in their foundry department. The Pennsylvania Iron Works Co. in their foundry department; Wm. Adams & Co., Bement, Miles & Co., and Pennsylvania Steel Co., at Sparrows Point, and others. On the matter of export trade we find it is increasing and bids fair to be an important factor in our iron industry."

Secretary Evans: There appears to be a good attendance of members from outside the city this evening. Perhaps it would be well to get some reports on the condition of trade in the different sections. I would suggest that Mr. Carpenter be called upon first.

Mr. Carpenter (P. Carpenter & Sons, Providence, R. I.): I did not come here for the purpose of talking. I do not know whether I can tell you much about the foundry business in Providence outside of our own works there. We are not particularly busy. I cannot say much for the rest of the foundries there. It does not appear to me as though business was increasing any, but rather decreasing. Prices are going down if anything.

Mr. Oliphant (Trenton Malleable Iron Works, Trenton, N. J.): The malleable iron business within the last two months has improved very decidedly as to quantity, but there is a slight decline in price. We think, however, from what we hear from our customers, that the outlook is decidedly encouraging. We have no general foundries in Trenton in the grey iron business. The grey iron there is produced principally by men who make machinery, and I believe we have the only general grey iron foundry in the place. Our grey iron business has increased as well as the malleable in the last two to three months. In January and December I think business was the very worst it has been for four years.

T. B. Harkins (Bristol, Pa.): I find very little improvement in prices—in fact, none at all. The volume of business is slightly improved and that is all I can say of a favorable nature. Prices are about as low as ever.

G. A. Messick (Harlan & Hollingsworth Co., Wilmington, Del.): We are about in the same fix as our friend from Providence. There is no business at all. It is not improving and prices are very low. I suppose if we could come down to the very lowest prices we could fill our shop with work. Things may improve soon; we hope so.

Francis Schumann (Tacony Iron & Metal Co., Tacony, Philadelphia): During the last four weeks it seems to me there has been rather a decrease in business noticeable, judging by the decreased demand for estimates. Instead of the improved appearance of business noticed four weeks ago we have rather the reverse, and the outlook does not seem to be very encouraging.

Mr. Hitzerath (Philadelphia): I concur with Mr. Schumann.

Mr. Mayer (Columbia Foundry Co., Columbia, Pa.): We are still running on short time, about four heats a week; sometimes we get in five. I do not know that prices have changed very much, but from the outlook reported by some of our customers business seems to be improving.

Josiah Thompson (J. Thompson & Co., Philadelphia): I cannot say that business has a more favorable aspect. Our business is just as it has been. While we are not dull, we are not busy. The volume of business is somewhat greater, but prices are about the same. The nature of the work offering now is somewhat undesirable in the majority of cases, and when we get it it is by the skin of our teeth so to speak. Business certainly is not improving.

Walter Wood (Camden Iron Works, Camden, N. J.): It is hard to say what our specialty will develop into by the end of the year. Up to the present time the cast iron pipe trade has been fairly good. Prices have followed the course of the market, and the possibility of increasing the business exists if people would only send their orders in.

Mr. Rankin (Abram Cox Stove Co., Philadelphia): We do not depend on orders at this time of year. We have a large warehouse and we keep on running. We shall have to depend upon the condition of pocketbooks in the fall of the year. About Christmas time if you call on me I can tell you something about what the season brings. At the present time we are going on making and storing away.

Mr. Ellicott (Southwark Foundry & Machine Co., Philadelphia): The Southwark Foundry still continues very busy, and they have booked two or three fair sized orders since our last meeting for some large centrifugal pumps and other work. They are extremely busy just at present.

Mr. Kavanaugh (Roberts, Winner & Co., Quakertown, Pa.): I can coincide with Mr. Rankin's report in regard to the stove business. We are running three days a week, and have been since last January. We are selling almost nothing, simply stocking up. We are in hopes of having better business in the fall.

Mr. Magel (A. & P. Roberts Co., Pencoyd, Pa.): We do no work outside of our own requirements, and that work is rather falling off. We are only running our foundry five days a week, but manage to keep the same number of men we have had all winter. There does not seem to be much of a prospect ahead.

George C. Davis, chemist to Thos. Devlin & Co., Philadelphia, then read a paper, entitled,

"NOTES ON MALLEABLE CAST IRON."

It is somewhat surprising that so little has found its way into print concerning malleable cast iron. So large a branch of the iron industry and one in which so many improvements have taken place in the past few years, certainly deserves more attention than it has received from the various writers on metallurgy. On looking over a number of books the writer was surprised to find that all of them dismissed the subject of malleable cast iron with a few lines giving only the most elementary information, and much of this was erroneous as it referred to ideas current before chemistry had thrown much light on the metallurgy of iron.

Turner made a few experiments regarding sulphur, but was evidently led to wrong conclusions in some manner. He states that there is a decrease in sulphur during the annealing; a statement which I cannot confirm. Indeed, my experiments showed that there is an appreciable increase, although it is too small to be of commercial importance.

Perhaps the most important change that has taken place is the substitution of coke malleable pig for the charcoal iron which was formerly exclusively used. With the advent of scientific management at the coke blast furnaces it was found that a low silicon iron could be produced which was nearly as low in sulphur as the charcoal irons commonly used by the makers of malleable castings. With this result attained it became merely a question of regulating the phosphorus and manganese to have an iron entirely suited for malleable work. The producers of coke iron did not long allow the charcoal iron men to retain their hold upon the founders who used charcoal iron exclusively. The common practice now is to use from one-fourth to one-half coke iron.

The writer has examined castings from a number of different works and the conclusions drawn from these analyses may be of interest. At any rate this paper may serve to provoke discussion and thus throw more light on a number of obscure points.

Silicon should range from .60 to .90 per cent to produce the best results. If below .50 the casting will be very tough, but will machine with difficulty to a smooth surface. The iron will have a torn look as if a dull tool had scraped along over it; the machinist will complain of hardness while an analysis will show no combined carbon. On the other hand, if this element exceeds 1.00 the casting will be noticeably weak. In making a mixture the metallurgist should take into consideration the method of melting. In the cupola the loss by oxidation is slight, but in the air furnace it is frequently considerable depending on the control of the air and the duration of time the metal is exposed to its influence. Three castings from different heats showed silicon 47., 56., 69., the original mixture in each case containing .75 per cent. silicon.

Sulphur in the amounts ordinarily present apparently has little effect on the toughness. The usual range is from .04 to .12 per cent., one of the toughest castings the writer ever saw containing the latter amount. This element is chiefly derived from the fuel. Hence in the cupola, when fuel and iron are in intimate contact more sulphur is absorbed than in the air furnace when the gases of combustion merely pass over the metal, which is protected to some extent by the slag. To return to the subject of pig iron it may be stated that charcoal irons range higher in sulphur than is commonly supposed. Few of them, unless high in silicon, are under .01 and they frequently contain .02. On the other hand, coke malleable is on the market containing less than .03, so the difference is in the third decimal place and too small to be of commercial importance.

Phosphorous is a weakening element, the usual range being from .15 to .22. If above the latter figure, a brittle casting will result.

Manganese is indirectly of great importance. Unless there is a sufficient amount of this element the metal sometimes acts as if it had become oxidized during melting. Whatever theory we may advance and whether this be the correct one or not the fact remains that mixtures deficient in manganese give trouble in different ways. The castings may be dirty, as the saying is, containing small masses of iron oxide, readily seen by the naked eye. An-

other result is a "scaly" casting, which usually shows itself after annealing and tumbling. In this case a very tough but thin skin, perhaps 1-64 of an inch in thickness, peels off of the casting. This is a rather rare occurrence fortunately. Castings of this kind showed traces only of manganese in the scale and .10 in the casting. The usual range in good castings is from .20 to .40. In making a mixture due allowance should be made for the usual loss in melting.

The amount of carbon in an annealed casting depends on its cross section and the time of annealing. Some typical analyses are for castings 1-8 inch thick, .15 per cent. carbon; 3-16 inch, .64 per cent.; 5-16 inch, 1.03 per cent., and 9-16 inch, 1.58 per cent. It sometimes happens that the carbon is more completely removed than these figures would indicate, thus one casting 1-8 inch thick showed .02 carbon, while another ¼ inch thick showed .05, but these are exceptional cases. Annealing being largely a surface change the outside is almost wholly decarbonized, while the inside remains unchanged. Thus in reporting the amount of carbon much depends on how the sample is taken. It is the writer's practice to break the casting under examination and file across the face, thus getting a sample representing the average composition with the report, noting size of casting and depth of decarbonization. Combined carbon, except in very small amount, does not exist in properly annealed castings.

The idea has been commonly held that to successfully anneal it is necessary to have the carbon present as combined carbon; that a gray casting could not be decarbonized. I believe this view to be erroneous and that it arose from confusing cause and effect. Now, "white castings" contain considerable graphite and yet anneal well. Secondly, it is reasonable to infer that the temperature of the annealing furnace would change the combined carbon to graphite in a few hours. Since an iron is gray because it is high in silicon, it is probable that the failure to produce a tough casting was not due to failure to decarbonize, but was brittle, due to high silicon. Of course the discussion of this point is purely academic, for if the silicon is right the casting will be white under the usual conditions. As an experiment I have taken a casting containing

3.00 graphite, and after annealing in the usual manner found the total carbon to be 1.25, all present as graphite. The casting contained 2.60 silicon and was of course brittle, but it had decarbonized as much as usual for castings of this size, viz.: 9-16 inch in diameter.

In this connection I wish to speak of sampling annealed iron for carbon determinations. This cannot be done with a drill, as the outside being decarbonized drills in large pieces like soft steel, while the inside which contains more graphite drills like a soft iron, and thus the chemist does not get a homogeneous sample. It is the writer's custom to take the sample with a file as previously described; the castings being held in a vice so that the filings may fall in a large sheet of paper. This gives a finely divided sample that is readily soluble in the double chloride of copper and potash.

Mr. Asa Whitney: Was there a larger amount of copper found in cases where the sulphur was high? In gray iron I have noticed that strong castings with high sulphur frequently contain more copper.

Mr. Davis: I have made but few determinations for copper, and have not found any.

Secretary Evans presented a question received from a foundryman for discussion concerning the delay experienced in legal proceedings for recovery of honest debts, and more particularly in cases where debtor appealed from a judgment, and the judgment creditor was prevented from receiving the benefits of his suit owing to the debtor being allowed to so appeal without giving security for the judgment. Many losses were entailed, it was mentioned in such cases from the debtor having plenty of time to make an assignment or otherwise serve his own ends.

Mr. Ellicott: We should have a committee on law, to which we could refer questions of this kind.

The meeting then adjourned.

WESTERN FOUNDRYMEN'S ASSOCIATION.

The annual meeting of the Western Foundrymen's Association was held Wednesday evening, May 19, 1897, at the Great Northern Hotel, Chicago, the President, A. W. McArthur, in the chair.

The following reports were read:

PRESIDENT'S REPORT.

To the Western Foundrymen's Association, Chicago:

Since this is the last meeting at which the present officers and board of directors will hold office it is proper that they submit to the association reports of the transactions of the year.

The report of the president which I now submit will be brief. In the matter of membership the association has not increased, but has held its own, which appears to me to be a satisfactory showing in view of the continued depression in business, the holding of the Presidential election, and the fact that the holding of our September meeting in Cleveland, O., as was planned, became impossible by reason of labor trouble among the foundries there. The financial condition of the association has materially improved and with considerable funds on hand, I believe that there are no debts outstanding, as will be shown more fully in the report of the treasurer to be submitted later. As will appear from the secretary's report, also to be submitted, numerous papers have been read and discussed, and these papers and the discussions on them have been very widely reprinted and have met with favor and have created interest in the work of the association in very many places. The discussion of topical questions, which has been kept up to a considerable extent through the year, has also been a source of much benefit, both to the members of the association and to the foundry trade. Several committees have been appointed which have submitted reports which seem to be of very great value, especially the Committee on Apprentices and the Committee on Cores. There has also been appointed during the year a committee to investigate the effect of the various metalloids on cast iron, and while the committee has not been able to report

or carry out to any great extent the purpose for which it was appointed, it has already done much work in the way of laying the foundations on which this work is to be carried, and I do not think that anything which the association has done during the past year will be of more permanent benefit than the work of this committee when finished.

There have also been discussed at length and adopted certain amendments to the by-laws of the association from the workings of which much good is expected. Whatever may be the result of these amendments I sincerely trust that since they have been adopted and the matter settled, the members of the Association will work together from now on in entire accord. I hope also that it will be possible to arrange this year for the holding of a September meeting in some other city than Chicago. I believe that our invariable experience with these meetings has been that very great good to the association has resulted from them.

I wish to congratulate the association on the fact that it has so far confined its work strictly to the practical and technical side of the foundry business, and sincerely trust that it will not in the future be led into taking up the commercial side of the business. Personally, I feel that I owe the association an apology for my absence from so many meetings; living at quite a distance from the city, it has often been impossible for me to attend.

In conclusion, I wish to thank the board of directors, the editing committee and the other officers of the association for the assistance given me, and particularly the secretary of the association. I also wish to thank the members of the association for their assistance in discussions and the invariable courtesy which they have extended to me.

Respectfully submitted,

A. W. McARTHUR, President.

SECRETARY'S REPORT.

To the Western Foundrymen's Association:

Gentlemen: As secretary of your association for the past year, I submit my annual report, which I will make as short as possible. At the last annual meeting the secretary reported 114 names on our membership roll. I regret to state that at present there are

only 110. The continued depression in business, together with the well-known effect of a Presidential canvass during the past year, have prevented the increase in membership which we had cause to expect. Since the last annual meeting we have elected 22 new members, which is an excellent showing when we consider the times passed through. We have, however, lost 21 members by resignation, one by death and four by failure in business.

An out-of-town meeting at Cleveland was planned, but unfortunately this had to be abandoned on account of labor troubles existing in the foundries at the time. As in the case of the Milwaukee meeting a considerable increase in membership was to be expected, which was thus lost by failure to hold the same. Of the resignations a number were carried over from the preceding year and were acted upon by the new board of directors. If these had been acted upon before it would have reduced last year's membership to 108 and would have shown an increase instead of a loss.

The interest in the work of our association continues throughout this country and Europe. The papers and discussions are widely reprinted and frequent comments of a highly eulogistic character are made in the trade papers as to the excellence of work being done. The following papers and topical questions have been read and discussed during the year:

June, 1896, "Power of Blast Penetration and Improvements in Center Blast," by Thos. D. West.

Topical question No. 6, "In your experience what is the most efficient method of cleaning light castings?"

Topical question No. 7, "What is the proper temperature at which to make cores? What method do you use for determining this temperature?"

July, 1896, "The Practical Value of the Various Metalloids in Cast Iron," by Malcolm McDowell.

September, 1896, "Compressed Air and Its Economies in the Foundry," by Curtis W. Shields.

"Compressed Air as a Hoisting Power in the Foundry," by George A. True.

October and November, 1896, Report of Committee on Apprentices.

December, 1896, Report of Committee on Drying Cores.

January, 1897, General discussion and collation.

February, 1897, Topical Question No. 8, "What is the proper amount of air, and pressure of same, to melt iron in the cupola, and what are the effects of too little and too much air?"

Discussion of Amendments to By-laws.

March, 1897, Supplementary Report of Committee on Apprentices.

"Phosphor Bronze; Its Manufacture, Properties and Foundry Treatment," by Max H. Wickhorst.

"Steel Cores," by George L. Roby.

April, 1897, Discussion and adoption of amendments to By-laws.

Your treasurer will give you a report of the finances of the association, but I wish to state that at present there are outstanding $432.50 of uncollected dues which, added to the cash balance on hand, makes the assets of the Western Foundrymen's Association $901.18.

I desire to thank the officers, board of directors, editing committee and members for the assistance rendered me and trust that their interest will continue, thus insuring the continued growth and success of our organization.

Respectfully,

A. SORGE, JR., Secretary.

TREASURER'S REPORT.

Balance on hand May 15, 1896	$ 368.97
Indebtedness May 15, 1896	000.00
Receipts from May 15, 1896, to May 15, 1897	1,062.25
Expenditures from May 15, 1896, to May 15, 1897	962.54
Balance on hand May 15, 1896	468.68

DETAIL OF EXPENDITURES.

Previous secretary's expenditures	$ 25.10
Printing and stationery	162.62
Postage	62.47
Stenographer	600 00
Exchange	2.75
Banquet, lunches, etc	97.50
Misc. expenses, express, telegrams, telephone, etc	12.10
Total	$952.54

Respectfully submitted,

O. T. STANTIAL, Treasurer.

The association then proceeded to the election of officers for the coming year, making choice of the following: President, C. A. Sercomb; vice-president, William Ferguson; secretary, A. Sorge, Jr.; treasurer, O. T. Stantial; directors, G. H. Carver, J. M. Sweeney, A. W. McArthur, W. N. Moore and S. T. Johnston; editing committee, B. M. Gardner, Henry W. Carter and E. E. Hanna.

After the election C. A. Sercomb, the new president, was escorted to the chair. Mr. Sercomb made a neat speech of thanks for the honor done him, and asked the aid and sympathy of the members during his incumbency.

The secretary reported from the board of directors for membership in the association the names of R. M. Dyer, Aermotor Co., Chicago, and R. M. Cherrie, Chicago. These gentlemen were unanimously elected members of the association.

A lecture written by Henry Gretener, describing the arrangement and operation of the foundries of Sulzer Bros. at Winterthur, Switzerland, which was illustrated by over 40 lantern slides, were read by the secretary.

This lecture is not published in these proceedings because it was delivered before the convention of the American Foundrymen's Association, at Detroit, under the title "A Modern Foundry in Europe," and will be published in the proceedings of that association and in the trade journals.

PITTSBURG FOUNDRYMEN'S ASSOCIATION.

The regular monthly meeting of the Pittsburg Foundrymen's Association was held in the Builders' Exchange, Pittsburg, Monday evening, May 24. In the temporary absence of the president, Robert Taylor, the vice-president, William Yagle, took the chair.

Benjamin D. Fuller, of the Westinghouse Electric Mfg. Co., responded to a paper read at a former meeting by G. G. Moldenke. He said:

"A cupola, to be run successfully, must be handled by a man who takes some interest and pride in the results; and, in these days of active competition, when men seem to forget that there is anything to live for except business, it behooves every foundryman to pay strict attention to his cupola. In the foundry of the Westinghouse Electric & Mfg. Co., where I am employed, we have, first, for the light work, one ordinary 72-inch, straight-line cupola, which was built by the Air-Brake Co., and which, I judge, was designed with the view of melting hot iron and running a constant stream, as it differs from most cupolas in having the wind box and tuyeres set quite low, the tuyeres being about 12 inches from the bottom. This cupola gives excellent satisfaction in the hands of a good man; but in times gone by I have seen it bunged up tight, day after day, hanging full for three or four feet, and, when knocked out, great patches of clay and fire-brick would adhere to the mass of slag and coke, leaving the shell exposed in large spots. The cupola man, when spoken to about it, would have first one excuse and then another. The blast was weak; the coke was not good; the clay was poor, etc. When the matter was sifted down, it came to this: The trouble was brought about by a too warm friendship between the cupola man and John Barleycorn. One man after another was tried until, in self-defense, a laboring man, or helper (a bright fellow) was given the job and educated up to the proper way of handling the cupola, and we have had but very little trouble for three or four years.

"Of first importance I hold good coke. In my experience I have seen, one day, iron melted with poor coke, dull and lacking life and fluidity, and when light castings from the heat were placed under the high speed drill, they were found to be very hard. The next day, with precisely the same mixture of iron and a different quality of coke, the iron was hot and fluid, and the castings proved to be fully up as to softness and strength. A good clean washed coke, low in sulphur, should be used where castings are light, and must be soft. In this class of work, requiring a very fluid iron, we find the best results, melting at a ratio of about 1 to 7½ or 1 to 8, with a blast pressure of about 10 ounces. This, again, depends largely upon the quality of the coke used. Our fan is a No. 8 Sturtevant blower, run at 2,000 revolutions per minute. The large pulley over which the belt passes which drives the fan, is on a shaft coupled up direct to a 25-h. p. electric motor, which gives perfect satisfaction. This is a good point in economy where the plant is large enough to have a central power plant with electric generator. My experience has been entirely with the Sturtevant fan, and from observations taken elsewhere I am inclined to believe that this style of blower is the best for the foundry. This, like everything else, is a matter of opinion.

"As to time of melting: We can melt as fast as we can handle the iron. I have seen the tap hole opened at 3:50 and not closed until 4:30; but this was when we had a large amount of bench work, and consequently a large number of men to handle the iron. This can be done by having a constant pressure from your fan and not being too skimp with the coke on the bed. From 1,540 to 1,550 pounds of coke on the bed, and 400 pounds between charges of 4,000 pounds iron, I find gives good results. In my estimation, eight tons per hour is good everyday melting.

"Our cupola is fitted with a slag hole, but this I have never found occasion to use, except where the melt was above 50,000 pounds when it was beneficial. Limestone or some equally good flux I would recommend for use. I have tried to do without, but the results do not pay.

"In speaking of slag, I will relate a little experience which we have lately passed through. Our firm sent from each Pittsburg

factory a car of scrap, among which was a lot of old annealing boxes and bottom, and, when this was used in as small an amount as 500 or 600 pounds, on the last charge it caused the slag to boil up the minute the fan was stopped, filling the tuyere box and running from all four peep holes, or openings, until the cupola was surrounded by a mass. When the bottom was dropped it resembled a lake of boiling taffy. This was repeated for several nights, and finally, in an effort to get rid of the stuff, 4,000 pounds were put on the last charge, together with some pig, to be run into a weight. What iron we got out of this entire amount was wheeled back to the cupola platform in one wheelbarrow load. What was in it you may guess; but if any of you get hold of such stuff sell it if you can, and if you cannot then give it away.

"The gates, sprues, and scrap from the day's heat should be put through the cleaning barrel before using. This will result in cleaner castings, and quite a saving can also be obtained by carefully picking over the coke from the bottom. But the use of much fine, small shot is not advisable.

"We also have, for our heavier work, a 72-inch Whiting cupola with large wind box, with double set of tuyeres, upper and lower. The upper set we have bricked up, as we can get more satisfaction from the use of the one set. This cupola is fitted with a No. 10 Buffalo forge blower, driven by motor at 1,400 revolutions per minute, and will melt at about the ratio of 1 to 8½ or 9, the iron required for this class of work not being so fluid. As I said before, the running of a cupola depends largely upon the man, the equipment, and last, but not least, the coke. I do not consider it economy to cut down to too great an extent the coke where hot, fluid iron is desired; but we must be governed by existing circumstances in all cases."

The responses to the invitation to discuss the subject were both prompt and numerous, and nearly all of the 30 foundrymen present participated. Later in the evening the subject, "Center Blast," was brought up, and, by request Mr. Thomas D. West explained by the use of a blackboard the workings of a center blast. Messrs. Yagle, Sterritt, Taylor, Fuller, Sleeth, Christian, Barker and McDonald spoke of various difficulties connected with the center blast, to all of which Mr. West responded.

A REVIEW OF THE FOUNDRY LITERATURE OF THE MONTH.

THE IRON AGE.

The molding of a difficult casting is illustrated and described in the issue of May 13. The casting, to which reference is made, is manufactured by the Mitchell Heater Co., of Poughkeepsie, N. Y., and forms the principal part of a boiler made by that company.

THE FOUNDRY.

Henry Hansen in "Examples of Shop Practice," describes a method of molding propellers. The article is illustrated with twelve views of various operations during the progress of molding.

In "The Modern (?) Foundry" a writer criticizes the commonly accepted theory that noted mechanics and modern machinery always denote cheap production. The following abstract will show the trend of the writer's ideas on the subject:

"The true guide as to the cost of castings is not determined so much by the cost of labor employed in its production, or the facilities used, as by the fixed charges, or expenses, aside from the actual labor necessary for its accomplishment, or the kind of workmen employed and quality of work produced. The producers—the men who actually make the dollars—are seldom the cause of expensive production. Although they are the men who stand the first reduction, the decreased wages and hours, they are the ones who suffer most, except, possibly, the owners, from every business depression. But the non-producers—the office men, superintendents, foremen, teamsters, watchmen, and others who have been employed during prosperous business periods, the practically non-producing element of the plant, the men who draw their salaries by the month or year, and occupy their desks or respective positions daily, whether the shop is running twenty hours a week or sixty, whether the concern is turning out two or twenty thousand dollars' worth of goods per month, who do nothing by their own physical efforts to increase the output, be-

come a burden, and rapidly eat up all the profits when the number of employes or producers is reduced, or contracts taken at close profits."

W. L. Hayden concludes a serial description of the "Down Draft Core Oven," and shows where an oven constructed on this plan is superior to one built in the ordinary way.

S. S. Knight, in "Theories Pertaining to Iron and Steel Discussed," gives voice to the following:

The results of the scientific and methodical investigation which has in the last ten years been applied with such signal success to the more difficult and abstruse problems of metallurgy, the development of the science of metallography, and the facts adduced therefrom, have no doubt been the means not only of solving many heretofore unexplained phenomena, but also of giving a great stimulus to work of this character, and hence of greatly augmenting the possibility of future discoveries.

In looking over the advancement which has been recently made, not forgetting that more real progress has been made in the last fifteen or twenty years than in all preceding time in iron metallurgical work, it is noticeable that by far the greater portion of the work has dealt directly with steel to the almost complete exclusion of cast iron. In the line of ordinary commercial steel work, the crucible has been superseded by the plain reverberatory furnace, this by the goose-necked furnace, and this, in turn, by the converter; and now the indications are favorable for the entire decline of this apparatus and the reinstatement of the furnace either of the acid or basic type. Solid fuels were succeeded by water gas; this by natural gas; and this, in turn, by producer gas. But in the field of cast iron the cupola is still used; the only essential modification being the central blast arrangement of the tuyeres and the use of steam in the blast. Together with these should possibly also be mentioned the use of small amounts of aluminum when used as an alloy with iron.

So far as the author is aware, his own was the first suggestion of the application of steam in the air blast of the cupola furnace. Long ago he began to search for some mode of reducing the

oxides of iron in the cupola in place of dissolving them in a flux of the alkaline earths. At first the so-called spathite ore was used, but with very slight success. After this, salts of the alkalies were tried with a view to decompose at a low temperature and set or vitrify the slag coincidently with or before the melting of the metal; while some reducing gas was at the same time liberated. At last the idea of using the carbon in the cupola presented itself; and, aided by a knowledge of the reactions which take place in a Siemens producer in the manufacture of producer gas, and also of that which takes place in a furnace where water gas was being generated, it was but the next step to utilize carbonous oxide gas, since its reducing power is well known. The only logical methods which presented themselves to accomplish this were: First, by duplicating the manufacture of water gas either by injecting live steam in the tuyeres and thus bringing it directly into the presence of incandescent carbon, or to form the gas in a furnace and inject it into the cupola. To the latter method there were two serious objections; first, it was not economical, since it necessitated the establishment and maintenance of a water gas plant; and second, the water gas thus injected would unite with oxygen before it could possibly reach the melting metal, because the carbon monoxide was in the presence of free oxygen and all that was required for its combustion under these circumstances was a high temperature. This it would obtain in passing through the glowing fuel while the oxide upon which it was intended to act was already in the slag, and consequently completely protected from its action. For these sufficient reasons the second method only was deemed feasible.

The author explains the theory upon which the manipulation of fuel and iron, under different conditions is supposed to rest.

Thos. D. West writes of "The Generation of Gases in Pouring Molds," and illustrates the effect a sudden liberation of these has upon the structure of the mold.

Robert D. Moore, in "Looking Backward," tells in a reminiscent strain some observations made during a busy life in many noted shops.

W. J. Keep, in "Cast Iron Notes," calls attention to the fact that the strength of test bars may be materially increased by tumbling. Mr. Keep presents a table showing the results obtained from a number of tests between bars cleaned by ordinary brushing and an equal number cleaned by milling. The author was led to make these experiments, by a set of test bars, which were sent him for examination, and which proved to possess more than ordinary strength, this being subsequently traced to the effects of tumbling, agreeing substantially with earlier experiments made by A. E. Outerbridge.

Mr. Keep, in the same article, offers the following advice to those using test bars:

To be able to compare records of tests of cast iron there must be uniformity of methods of testing. Test bars in every foundry should be molded in No. 1 stove plate sand, and should be molded from the same form of pattern, and gated in the same way, and no facing used. The iron should be taken at the middle of a heat in a hot ladle, and all bars should be poured from one ladle as quickly as possible. Take the bars from the sand as soon as possible, break from the gates, and remove sand by a wire brush or scrape one bar with another. Grind off any portion of the gates that may adhere with an emery wheel. Place the bars in the testing machine in the same position as they lay in the mold, and test the bars as soon as possible after they are made. Each founder should pursue this exact routine.

While each detail seems unimportant, yet no one knows how a slight variation may influence the strength. I prescribed the above routine in 1885, and have never deviated from it in any detail, therefore all of my tests are comparable. Bars made or tested by any other routine may be either weaker or stronger.

THE IRON MOLDERS' JOURNAL.

R. Watson writes on "Force of Habit," and shows how this affects the lighting of vent in molds of different shops. He says:

As a rule the instruction to the skimmer is to "touch off" the vents as soon as they will light. The idea among molders is that

this causes the gas to escape more freely and thus lessens the possibility of a "blow." This idea is a mistaken one, as I have demonstrated by practical experience on more than one occasion. My conclusion is further verified by good authorities, who inform me that manufactured gas will escape just as freely from a gas jet and register the same volume at the meter whether it is lit or not, the flow depending entirely on the pressure at the gas tank. That is exactly the case with the gas coming from a mold in the process of casting—the pressure from within determines the velocity of its escape. The gas is forced through the vents not drawn through them, and if they are too small for the volume of gas to be carried off, lighting them will not facilitate its exit or save a piece from blowing.

An illustration and short description is given in this number of the Birmingham Foundry Co.'s shop at Derby, Ct.

The "Characteristics" of those engaged in different branches of the trade are set forth by "Squire," whose observations seem to closely agree with actual conditions.

MACHINERY.

Phil Pastre illustrates a method of making bronze or copper tuyeres for blast furnaces.

C. Vickers writes an article on "Babbitt Metals" and gives several mixtures of metals, which have been found to work well in practice.

THE TRADESMAN.

E. H. Putnam, in the issue of May 1st, has the following to say on "Coke Iron for Car Wheels:"

It is said that one of the great manufacturers of car wheels made some millions of dollars before any of his competitors found out that he was using principally coke iron. Coke iron is used in car foundries for various parts of the work as a matter of course, and so it was not a matter to excite notice that a car factory used a good deal of coke iron. Of course, everybody who has had much experience in this line of work knows that coke iron is non-chilling, and therefore nobody would suspect that any

such iron was being used in the manufacture of car wheels. Nevertheless, coke iron was and is now used very extensively in the manufacture of car wheels. For, though the natural product will not chill, yet by the addition to or admixture with it of ferromanganese in right proportion most excellent car wheels, it is asserted, can be produced. Nay, it is said by persons who ought to know, that wheels of this brand are equal to any. If this is true it certainly marks a tremendous onward stride in the development of iron founding. A few short years ago it was thought that only cold blast charcoal iron, a very costly article, was fit for the manufacture of malleable iron, and now everybody uses at least 80 per cent. of coke iron in malleables. And one may readily see what a saving to the world would be the employment of coke iron in the car wheel product. And, if we can now use coke iron by adding another ingredient, it would seem reasonable to expect of chemistry that soon a means may be found of producing at the furnace a true chilling coke iron. Of course I do not mean to say that coke iron is not nor has not been used in chill iron mixtures, but it is so used merely as a softener. Cold blast charcoal iron is intensely chilling in tendency and to modify this tendency a softer iron, having less tendency to chill, is mixed with it. And because coke iron is not inclined to chill and is much cheaper than soft charcoal iron it is selected as a softener to mix with a high chilling charcoal iron. Some founders, in order to reduce the cost of product, will use a very close, hard coke iron with a comparatively soft charcoal iron in order to get a larger use of the cheaper factor in the mixture. But very great caution should be observed in a movement of this kind, for a very hard coke iron is a very weak iron in small castings.

In the issue of May 15th, Guy R. Johnson, writing on the same subject and partly in reply to the above, says:

* * * * My contention is, and I stand ready at any time to prove it, that the making of iron by coke has no more to do with the chilling properties than the moon has. The only element that really has any influence on chilling is silicon, which, however, in turn, is somewhat modified by the other elements, as will

be shown later. This is to say, if an iron containing an average amount of combined and graphitic carbon, and the usual amount of phosphorus—.75 to 1.00—but low in silicon, i. e. below 1.00, be run into car wheels (against a chill), it will produce just the same amount of chill as a charcoal iron of the same analysis. The objection to the use of such iron as this is that the line of demarcation between the chill portion and the gray portion of the wheel would be practically a straight line. If, however, the phosphorus be reduced to from .25 to .45, all other elements being equal, the coke iron, or the charcoal iron, will show the same amount of chill, but instead of showing a straight line of demarcation the chill will extend sharp points down into the gray portion of the metal; in other words, will form an interlacing chill.

Considered chemically, chilling consists merely in combining all of the carbon locally. Silicon tends to make carbon graphitic, therefore, if too much silicon be present, the iron will not chill. Sulphur has a tendency to turn graphitic carbon into combined carbon, but has the disadvantage of giving a brittle product, although a very hard one. Phosphorus has a tendency to convert combined carbon into graphitic carbon. Now, if Mr. Putnam will put these facts together, and will take the analyses of a good standard charcoal iron used for car wheel purposes, and a good coke iron used for the same purpose, he will find that the only reason charcoal iron has had the advantage in past years is that, being made in a colder furnace, it has more combined carbon, and for that reason gives greater tensile and traverse strength. If, however, the coke iron be made so as to be high in combined carbon, the charcoal iron will have no advantage.

If he will further take the trouble to investigate, he will find that several concerns either use no charcoal iron, or very little, and that they get their hardness from sulphur. It is this latter fact which has caused the Pennsylvania Railroad to institute the thermal test, because a wheel not made from low phosphorus iron and with too much sulphur has a tendency, as above stated, to crack at the line of demarcation between the chill and the gray

metal. With a low phosphorus, interlacing chill iron this is an impossibility. So far as the use of ferro-manganese goes, manganese serves in two ways, to slag off the sulphur when there is too much present, and also to make the iron closer grained and harder when suddenly cooled. The white edge around some foundry iron is an illustration of this.

MECHANICAL ANALYSIS OR CHEMICAL ANALYSIS FOR REGULATING FOUNDRY IRON.

By W. J. KEEP, in The Foundry, July, 1897.

Chemical Analysis.—By this term it is understood that each carload of coke and iron which is received shall have its chemical composition determined. The chemist shall know what composition is best for each kind of castings, and shall calculate how much of each pig iron shall be used to produce the desired chemical composition in the casting, and it is claimed that this will produce a corresponding physical character. In practice, silicon, and possibly sulphur, are the only elements determined.

Physical tests are generally understood to be the breaking transversely, or by tension, a test bar which has a cross section of one square inch. Chemists sometimes recommend that this test be used in connection with chemical analysis.

Mechanical analysis is founded upon my discovery in 1885 that the shrinkage of a test bar varies inversely as the silicon in the casting. In other words, the measure of shrinkage is practically equivalent to a chemical analysis of silicon. It is also founded on the fact that the physical properties, aside from shrinkage and softness, are not wholly dependent upon the chemical composition of the casting. Mechanical analysis measures the physical properties of the iron, which are shrinkage, strength, deflection, set and depth of chill. Each foundry fixes upon its best record as its standard. If the shrinkage is higher than the standard, more silicon is needed; if lower, less silicon is required—that is, the more scrap may be used.

Chemical and mechanical analysis each determine whether more or less silicon is needed, and both aim to produce castings having the best physical composition. Each approaches the subject from an opposite direction. The chemist calculates a chemical composition which he predicts will produce the desired physical composition. To find whether his calculation was correct, it is necessary for him to determine the physical quality. The

mechanical method measures the physical quality first, and the variation in shrinkage tells what mechanical change is needed to more nearly reach the standard.

Cost of Each Method.—The use of chemical analysis requires the installation of a laboratory at an expense of from $200 to $400. To this must be added the employment of a chemist, the expense of chemicals and breakage of apparatus, fuel and assistance, which would cost about $2,500 each year. Mechanical analysis uses an apparatus costing about $200. Test bars cost but a few cents, and the foreman can determine the physical quality in a few moments.

It can be used alone, as it gives all necessary information, but the most complete results would be obtained by a combination of both methods.

Foundation Principles.—These have been determined by a combination of mechanical and chemical analysis.

A test bar having a section of one square inch broken transversely will not indicate the strength of irons having different chemical composition, as well as bars either smaller or larger than one inch. The reason for this is that a test bar having a one-inch section gives nearly the same strength for irons which differ widely in chemical composition, while a test bar one-half to three-quarters of an inch square, or larger than two inches square, gives a record which varies more nearly with changes in chemical composition. The fact that a one-inch test bar gives nearly uniform results for all irons has created the impression that this size was especially desirable for use as a test bar.

Very little has been added to our knowledge of cast iron by tests made with a test bar of one square inch section.

The size of test bar which shall show the greatest variation in strength and shrinkage for the smallest variation in chemical composition, is the best size for mechanical analysis.

An increase of silicon will change combined carbon (white iron) into graphite (gray iron), and in this way removes brittleness and hardness, makes the grains more open and reduces shrinkage

An increase of silicon, because of its removing brittleness, generally increases the strength of small castings, but it decreases the strength of large castings poured from the same iron.

An increase of silicon will generally overcome the influence of sulphur, or any other adverse influence.

When both are poured from the same iron, a small casting which cools quickly will have a closer grain, and will thus have greater strength than a large casting which cools more slowly.

The slow cooling of large castings gives more time for silicon to act on carbon, and the grain is therefore more open and the casting is consequently weaker in proportion to its size.

For these reasons the strength and shrinkage of castings cannot be correctly calculated by any mechanical formula which uses the strength and shrinkage obtained from a test bar of a different size.

I have constructed a chart by which, with any size of test bar, the strength or shrinkage of any other size of test bar or casting can be closely approximated graphically.

To locate two points on the curves in this chart, I would recommend the use of two sizes of test bars cast from one gate, one of which shall be half an inch square and the other one inch square.

Whether chemical or mechanical analysis is used, any estimate regarding the physical quality of a casting is only approximate, because conditions attending melting which are not under the control of the melter and cannot be provided for, often exert a greater influence on the casting than variations in the chemical composition.

Drawbacks to Chemical Analysis.—A chemist must be employed and a laboratory provided. To be successful even in a small foundry, the chemist must give his whole time, if each iron and the coke are to be subjected to anything like a complete analysis.

Analysis has been found to be slow, especially if other elements than silicon are determined.

For this reason it is necessary to purchase iron far in advance of needs, and there must be room to pile each carload by itself.

This adds to the expense of transportation from the yard to the cupola.

With limited yard capacity, pig iron must be piled quite high, and when used that on top must be used without reference to its car number, in which case analysis would be of little use.

If, as is usual with small founders, iron is purchased as needed, there would not be time for analysis.

There is always a difficulty in sampling. Chemists are not agreed as to the most desirable part of a pig from which to take drillings, and a few grains of sand from the surface would render analysis worthless. The chemist would be obliged to watch each step, for the class of men employed in a foundry yard cannot be entrusted with this work.

Pig iron is not homogeneous, therefore drillings taken from one part may not represent the average of the whole pig, much less of the whole carload, even if the drillings are taken with twenty-five pigs.

The small fraction of an ounce of drillings used for the determination of the chemical composition of a carload of iron makes the chance of error very great.

In most foundries a large proportion of scrap is used, and as each piece of scrap comes from a different foundry mixture, no correct analysis can be made.

Scrap iron has been melted in a cupola, and the appearance of its fracture is a more reliable guide as to its quality than the appearance of the fracture of pig iron.

The appearance of the fracture of pig iron does not always indicate the character of the iron. One iron with a very close grain, but containing considerable silicon, may make very soft castings, while another dark open pig iron deficient in silicon may make castings which are nearly white.

This fact makes chemical analysis of pig iron very desirable, though fortunately the appearance of the fracture generally indicates the quality.

On the other hand, two irons showing exactly the same chemical composition will sometimes produce castings having totally different physical qualities.

The chemist does not like to admit this fact, because the success of chemical analysis depends upon the supposition that the same physical quality always accompanies a given chemical composition, and it cannot take account of the unforeseen conditions which often entirely alter the physical character of the castings.

Strength is almost entirely dependent upon the size and shape of the grain, and is not to any great extent dependent upon the chemical composition.

Some chemists who are aware of these facts advocate physical tests as an accompaniment to chemical analysis.

These difficulties in the way of chemical analysis exist, but the fact remains that this is the only means of determining the chemical composition of the iron in percentages.

Advantages of Mechanical Analysis.—It is cheap and quick, and can be operated by anyone of ordinary intelligence. It tells the founder exactly what physical properties his castings have, and tells him exactly what to do to bring each physical quality to standard. It tells whether more or less silicon is needed to overcome all influences, whether due to chemical change or adverse conditions which cannot be foreseen.

The founder will order chemical determinations when needed to check his work.

If it is desired to purchase a lower priced iron, order a carload and substitute a small quantity of it in the mixture in place of an equal quantity of the iron which it is to replace.

If the shrinkage decreases it is a better scrap carrier than the other. If the shrinkage increases, silicon must be made up in some other way, and the new iron may not be economical at a reduced price. The same process tells which irons in a mixture are most economical, and which contain most silicon.

The objection made by chemists to mechanical analysis is that it gives information after the castings are made.

Mechanical analysis assumes that the founder uses more than one iron in his mixture (the more the better), which would prevent variation in different parts of a pile of iron from exerting a decided influence on the castings, and that he makes no radical

change at any time. When a change is made, it is to get closer to the standard or to reduce cost.

If only untried irons were to be charged, chemical analysis would be of considerable advantage, though as a general thing the appearance of the fracture would be as safe a guide.

When this first cast was made a chemical analysis would be made,which would show the exact quality of the casting and what change was needed, without its being necessary for the founder to examine into the reason for the lack of uniformity between the chemical prescription for the mixture and the physical result. For the second day, and ever after, mechanical analysis is, at least, as good as chemical analysis.

There are classes of special work requiring specific percentages of one or more elements, where chemical analysis must be employed.

Antagonism to Mechanical Analysis.—There is no reason why the chemist should oppose it, because both mechanical and chemical analysis employ the chemical elements in exactly the same way to alter the physical quality of the casting, and all agree that the more chemical determinations, the better.

Antagonism seems to be caused by the fact that a founder, when necessary, can get along very successfully with mechanical analysis.

Antagonism seems to come from chemists who are not acquainted with the requirements of foundry work, and who do not understand mechanical analysis.

It also seems to come from chemists who have laboratories, and who wish founders to send drillings to them and allow them to direct the iron mixture from a distance.

It seems to come from chemists in the employ of founders, who do not desire to assume the practical position of foreman, and are aware that mechanical analysis could be employed without their help.

It also comes from founders who neither understand chemical or mechanical analysis, and who imagine that because chemical analysis requires the employment of a man of education, it must be the scientific method.

There should be no antagonism. The result is exactly the same by either method. It is only a question of which is the best way to get at it if only one can be employed.

Which is the Most Scientific Method?—Those antagonistic to mechanical analysis occasionally call it "rule of thumb."

The most scientific method is that which is founded upon the most correct principles, and which gives the most correct information in the quickest way, and which can be used by them who need it.

It is not necessary that a scientific method should be one which can only be used by the graduate from a chemical school, and it is not certain that methods which can be used by every founder are for that reason "rule of thumb."

The results obtained by the use of a method must determine its value.

Chemical analysis alone, or even when accompanied by the ordinary transverse breaking of test bars having a one-inch section, has done very little towards determining in cast iron the influence of the ordinary chemical elements upon the physical quality of cast iron.

Professor Thomas Turner, of Birmingham, England, in 1885 made ten series of test bars in which silicon was the only variable, and by physical tests proved the influence of silicon. The chemical analysis of all elements added greatly to the value of the tests, but was not the means used to determine the influence of silicon.

Nearly all of our present knowledge regarding the influence of carbon, phosphorus, sulphur and manganese has been gained by making a large number of series of test bars in which a single element varied, and then and then determining its influence by mechanical analysis. The amount of each element in the irons melted and in the test bars was found by chemical analysis, but this did not give any idea of the influence exerted.

The change was physical, and could only be found by physical methods.

Before mechanical analysis could be used in the foundry to control the iron mixture, it was necessary to determine the influence of each chemical element.

Founders who are thorough chemists soon find that the most practical way to control their mixture is by mechanical analysis.

For a number of years there has seemed to be one exception to this. One founder who is a practical chemist opposed mechanical analysis, and claimed to arrange each day's mixture in his foundry by pure chemical analysis, and he said that he found an exact correspondence between his chemical prescriptions and the physical results. When asked to explain his method, he claimed that it was his own secret.

In January of this year (1897) he presented before the Foundrymen's Association of Philadelphia a paper describing his castings, and explained his method, which was the determining of shrinkage, chill and strength by physical tests, and he uses the following language regarding his mixture: "Its physical characters were *attained by properly calculating the ultimate chemical composition for cupola charges and* maintained without regular analysis of the casting, *by translating* the small daily variations in physical test pieces and castings *into chemical equivalents*, indicating the *chemical* change to be made on the charge. Thus in spite of the usual cupola return of scrap, and other adverse conditions, the charges are regulated to produce practically equivalent castings."

I have placed all words which treat of imaginary processes in italics. Now read again the part in ordinary type, and you have as good a description of the mechanical analysis as I could formulate.

The user of mechanical analysis is using chemistry all the time, but says and thinks very little about it. He has only time for results.

Before I undertake any investigation I get the best chemists in the country to join with me. Messrs. Dickman and Mackenzie, of Chicago, have made the determinations for most of this work since 1894. I have never had any cause to oppose chemical analysis where it is practical to employ it in the foundry

When the chemist becomes the practical founder, there is no antagonism between chemical and mechanical analysis.